THE RAILWAY REVIEW

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Graphite on Rails.—On the Halberstadt-Blankenburg Railway, in Germany, graphite is reported to be in successful use for lubricating the inner vertical faces of the outer rail heads on curves, says Industries and Iron. It is ground very finely and mixed with just enough water to form a thick paste, and when applied to the rails dries quickly, and the thin layers formed adhere a reasonable time to the rails. During the wet season of the year it appears that there is no necessity for lubricating the rails. Experience shows that in dry weather it is advisable that the line watchman should lubricate the rails every five days, although, doubtless, the frequency of the lubrication will depend upon the amount of traffic. On the Hartz line, it is said, the trains are hauled by six-wheel coupled engines, with trailing Bissel truck. Prior to the introduction of graphite lubrication the tires had to be turned every four or five months. The original tire material, which was too soft, was replaced by Krupp crucible cast steel, and at the same time the lubrication of the outer rails introduced. The tires now need turning only after they have been in service eighteen months or two years. The same lubricant is also used on the sections of the line which are worked on the Abt system for lubricating the rack and spur wheels.

Coal Wash.—Anent the various ways in which coal may be, and is, allowed to go to waste in all coal mining regions, it is worth noting that, according to an estimate of the late Eckley B. Coxe, the amount of coal lost in preparation and sent to the culm banks in the anthracite districts of Pennsylvania, since mining began, has been 35 per cent of the total production, or, up to the close of 1892, a toal of 315,700,000 tons. At certain collieries, from the year 1820 to 1883, 20 per cent more coal had gone to the dirt banks than had been marketed, and from 50 to 75 per cent of total shipments to dirt banks was not unusual. In view of these facts, the statement that, on the average, during the last fifty years not more than 30 per cent of the coal mined has reached the place of consumption is at all surprising.—[Cassier's Magazine.

Paints for Metals.—An account of some interesting researches on the value of paints for iron work, made by Prof. J. Spennrath, has recently been published in the "Deutsche Bauzeitung." As one result of these, Prof. Spennrath concludes that none of the metallic oxides commonly used combine chemically with linseed oil. The drying process depends exclusively on an absorption of oxygen by the oil, which is facilitated by the presence of the pigment in a purely mechanical way. The value of the different pigments used varies. Thus, zinc white, when used for outside work, rapidly swells to double its previous volume, owing to the absorption of carbonic acid gas and water. Sulphuretted hydrogen will cause red or white lead to act in a similar way, but, when pure, Prof. Spennrath considers these two latter pigments satisfactory. Carbon paints are very stable, as is heavy spar, but the covering power of the latter is small. In order to test the relative durability of various paints, sheets of zinc were coated with a number of different kinds. The zinc was then dissolved away by acid, leaving a film of paint. All these films, it was found, could be destroyed by the action of dilute nitric or hydrochloric acids, while the vapors of sulphuric and acetic acids acted similarly. Alkaline fluids and gases also destroyed the paints rapidly. Pure water was found to be more injurious than salt water, hence the destructive action of sea water is to be attributed mainly to the mechanical effects of wash. Hot water was found to act more rapidly than cold. The most important discovery made was, however, the great influence of temperature. Films similar to those already described completely lost their elasticity and became brittle when exposed to a temperature of 203 deg. F. There was at the same time a large contraction. Similar effects are produced by prolonged exposure to considerably lower temperatures. Blistering he finds to be due to the inner coat of paint being so thick that it has not hardened thoroughly before the second coat is applied.

The Atlantic and Mediterranean Canal.—The proposal to construct a ship canal between the Bay of Biscay and the Mediterranean Sea has not met with much encouragement, according to English journals. This is a scheme which has been much talked of for many years. A water way of that kind through France would, it is said, have many advantages, commercial as well as strategical. It would not only shorten the length of voyage between the northern ports of Europe and the Mediterranean, but would prove a valuable channel for the French fleet in time of war. There would then be no need for French battleships exposing themselves to fire from the grim watch dogs of Gibraltar. There is no difficulty in the project from an engineering point of view; the difficulty is mainly a financial one. The canal would probably be from 220 to 300 miles in length, and it is estimated that the cost would not fall short of 50 millions sterling. It is not at all likely that any traffic that might choose to pass through the canal would ever render it a profitable investment, for although the distance traversed would be considerably shortened, little time would be saved owing to the delays of passing through the numerous locks. France does not seem prepared at present to pay so much for any strategical advantage the scheme might offer. The commissioners appointed by the French government to investigate the proposals have simply expressed their disapproval. In a time of war, however, it is possible they might take quite a different view of the matter.

Reasons for the Siberian Railway.—Siberia is a Russian Canada, larger and more populous, and, like Canada, it has a great future before it, says the Fortnightly Review. It is very rich in gold, while there are whole hills of graphite (black lead) and lapis lazuli; coal can be picked up on the very road near Nerchinsk there is silver in the same district, and there are rich mines of iron near Nikolaefsk. Siberia, like Canada, is rich in fish. On the Amur river 200,000 puds of the kita fish have been caught within a few weeks in August, when the fish ascend the rivers; the pud (pood) being 40 pounds, that means 8,000,000 pounds of fish. In the Khabarofka museum is a stuffed kaluga fish weighing 30 puds, or 1,200 pounds, caught in the Amur. The Russians have been struck by the fact that "the prosperity of Canada and its productive activity have grown, and continue to grow, with a rapidity which appears to us (Russians) miraculous, and by us inimitable, just from the date of the completion of the Canadian Pacific Railway from the Pacific to the Atlantic Ocean." In 1889 they deputed two engineers to observe the Canadian line and its conditions and results. Attention in Russia was drawn to the facts that Canada, a country then of 4,000,000 people, had, by its own resources, without any pecuniary help from outside, connected the two oceans by an iron road 4,500 versts (3,000 miles) long, over very difficult and expensive ground for building, in the short time of four years; that the energetic population of Canada, 3,600,000 in 1871, and only increased to 4,300,000 in 1881, reached 5,000,000 a year or two after the first through train passed Winnipeg in 1886; that the quantity of grain carried in Canada had increased from 303,571 tons in 1886 to 500,000 in 1888; that in places without population there had arisen seven new towns, such as Vancouver, founded only in 1886, and holding 9,000 inhabitants in 1891. It was made known to Russia that "the cost of the Siberian Railway should not be even 65 per cent of the cost of the Canadian Pacific."

Good Iron.—In removing a cast iron bushing of a locomotive cylinder recently at the Baldwin Locomotive Works, the excellent quality of the iron was strikingly illustrated. The cylinders were originally about 20 in. in diameter, and for some reason had been bushed to 19 in. by the builders. It was decided to remove the bushing, and it was cut out with a boring bar until a thin shell was left in which the metal was 1-32 to 1-8 inch thick, forming a complete cylinder. When the shell was cut open the metal spread out flat like a piece of sheet iron —[Foundry.

Development of Trade in Japan.—The last consular report of the trade of Japan has much that is interesting, if it is not quite startling, to the industrial communities of this country, says an English journal. In this report we are informed of the promotion of new industries, such as railways, spinning mills, sugar and silk factories, to an extraordinary extent. Numerous foundries are to be seen in full blast in all the great towns. Engine works are busy making copies of our machinery from samples purchased in Europe, and the copies are said to be little, if any, inferior to the originals, for the Japs show great aptitude at imitating what they see, so long as it is outside the region of the fine arts. They are succeeding well in the construction of locomotives, and complete them at much lower cost than they can be made for here. The total exports of Japan have increased five-fold in the last 24 years, and the imports rather more than five-fold. It is refreshing to read of so much prosperity, for we are not among those who see in this great development of industries in the far east formidable rivalry to British trade. Cheap labor does much to help Japan at present, but she cannot always have cheap labor if trade expands to a much greater extent. Already in some industries there is a scarcity of labor and wages have risen to an unprecedented figure. Things will right themselves there as elsewhere, and it will be found that there is room enough in the world for all.

Sand Sidings. — Before the March meeting of the Verein fur Eisenbahnkunde Prof. Koering read a paper by himself and Mr. Kopcke on sand sidings. One of the Dresden lines enters the station with an incline of 1.55. Some years ago a goods train became unmanageable and an accident was the consequence. A sand siding was constructed, that is to say, a siding with two smaller rails, first on a level with the main track, then lower and covered with sand, confined by longitudinal sleepers. Such sidings, well known in England and not uncommon in Saxony, for instance, have been objected to as involving the risk of smashing any lighter cars coupled between heavily laden trucks. Various experiments did not satisfy the doubters. In December last the same locality was the scene of another occurrence of this kind. This time, however, the train, as the report in Glaser's Annalen shows, soon came to a standstill, and no damage was done, although the fifth car was empty, and several others between the ninth and twenty-fourth cars were almost so. The train could go on after a delay of 24 minutes. The sand siding has a length of 500 yards; for smaller gradients shorter lengths are sufficient. The expedient answers also during frosty weather.

Electric Steel.—From Europe comes a report of a new process for the electrical treatment of steel for which most extraordinary claims are advanced. Indeed, so wonderful are the results said to have been achieved, that it is surprising that the new process did not orignate in America. The report says that M. Taux, of Strasbourg, has carried out the following experiments in the presence of a committee of engineers: 1. A drill tempered by electricity pierced through a piece of steel quite as quickly as a drill of the best steel tempered in the ordinary way would have done. 2. A circular saw tempered by electricity severed bars of iron with an ease that was surprising. 3. With shears of electric steel a bar of steel 1¾ in. wide and ¾ in. thick was cut in two in a cold state, and the operation was repeated five times on the same bar, and no alteration whatever was observable on the edge of the shears. 4. A simple table knife tempered by the new process cut 11 times in succession a piece of iron wire 1½ millimeter thick as easily as if it had been a piece of string. It is added that the process consists in dipping the tools, after being heated, into a conducting bath traversed by an electric current, but this is all the information vouchsafed, and we shall have to wait patiently, and perhaps in vain, for more definite particulars of the process.

A New Departure in Magnesium Lights.—Magnesium for flash or "torch" has been very popular for some time past, but ribbon or wire is very liable to "give out" just when the light is most needed, except when special precautions are taken or arrangements made. But the new method of burning seems to offer a perfect medium of actinic combustion. It consists in the "sandwiching" of magnesium powder between sheets of paper impregnated with potassium chlorate. Magnesium powder is placed between two sheets of paper, which have been pasted over with starch. The whole, when dry, forms one single sheet. Next each side is covered with a piece of paper impregnated with potassium chlorate, and the whole covered with a further sheet of paper pasted on each side, a thick sheet almost like cardboard, being thus produced. It may then, when perfectly dry, be cut into lengths and ignited as required. According to the Journal of Chemical Industry, the combination is quite safe and keeps well.

The New East River Bridge.

The preparatory work for the construction of the new East River Bridge between New York and Brooklyn was begun in the form of preliminary borings, June 19.

Soundings were taken off Fifth street on the Brooklyn side, and rock was struck in the stream at a depth of sixty feet. These operations are being pushed forward as rapidly as possible, and will be continued off Delancey street on the New York side, as soon as practicable. Work on the structure received an impetus from the decisive action of the commissioners in adopting the plan providing for a straight approach at Clinton and Delancey streets, New York, and Fifth and Roebling streets, Brooklyn. The New York approach, as now definitely determined, will extend over the two blocks bounded by Clinton, Delancey, Norfolk and Broome streets.

The commissioners expect to have the work well under way in September and that it will be completed before the close of the year 1900. The structure is to cost $15,000,000.

The new bridge will be similar to the present Brooklyn bridge. The weight will be carried by four immense cables of steel. In the older structure the cables are strung on granite piers, but in the new bridge the towers will be of skeleton steel. The site for the foundations or anchorages of the two piers has been determined, and the boring is now going on. Just beyond the head of Delancey street wharf four holes have been bored in the bed of the East River with diamond drills, and the results attained have given assurance that a solid gneiss rock lies at a depth of sixty-one feet below water on the New York side. In descending to the rock foundation to build the piers, the method to be employed will be the same as in the work on the Brooklyn bridge twenty-five years ago. Caissons will be constructed, probably of steel, instead of wood, as formerly, and these will be sunk by weights of masonry. In the chambers within the caissons, to which the water cannot penetrate, the workmen will clear the rock of all earth and prepare a foundation of cement and broken stone. The two towers of steel will rise 332 ft. above the water. Each tower will rest on four legs standing on the four corners of each caisson. About 117 ft. above the river there will be an arched space, through which the main roadway for cars and foot passengers will pass.

There will be six railroad tracks, two for elevated railroad trains and four for electric and other surface cars. Above this roadway, it is proposed, broad footways will be constructed and also a bicycle path. Upon the level of the railroad tracks and between the legs of the towers will be an arched space on each side of the large one, for use as carriage ways. The width of the new bridge will be 117 ft., or 37 more than the old one.

The span from tower to tower will measure 1,610 ft., 15 ft. longer than the Brooklyn bridge. The

cable will be about 18 in. in diameter, three inches greater than those now supporting the enormous traffic between the two cities. In each cable will be 5,149 wires, and every strand will be capable of carrying a load of 5,000 lbs.

Mr. L. L. Buck, chief engineer, proposes to have each of the four cables constructed and then brought to the bridge, instead of stringing each wire separately across the river, the operation which was followed in the construction of the Brooklyn bridge. In general, the structure of the approaches will resemble that of the high curve on the Sixth avenue elevated road at One hundred-and-tenth street. The elevaetd railroads will run from their present hight on to the bridge, while the carriage roads, trolley lines and foot passengers will all ascend the bridge from the street level.

ENDLESS FREIGHT CONVEYOR.

The illustration herewith shows an endless freight conveyor for loading and unloading vessels, designed and built in 1894 by the Link-Belt Machinery Company of Chicago, for the Texas & Pacific Railroad Company's dock at Donaldsonville, La.

The conveyor is carried by a steel truss, hinged at the inboard end so that the outboard end may rise and fall with the varying hight of deck of vessel. The power for driving is furnished by a reversing engine attached to the side of the truss at the inboard end and coupled direct to a pinion shaft which drives the conveyor. The width of the conveyor apron is 48 in. and the blocks are placed, as may be seen in the cut, at intervals, for holding barrels as they go up the incline, and also for preventing bales or boxes from running back when sent up that way. The capacity of the conveyor is limited only by the number of men that can handle and take care of the freight, and it is claimed that by its use a saving of about 25 men may be effected in discharging a cargo. This type of endless apron freight conveyor has been installed at warehouses of Union Steamboat Company, and Western Warehousing Company of Chicago, and also at the Southern Pacific Railway's Algiers dock at New Orleans.

ENDLESS FREIGHT CONVEYOR.

The Seaboard Air Line, properly known as the S. A.L., has just issued a beautifully illustrated summer book full of pictures of the lovely region which it reaches. On the outside front cover is a half-tone of a lovely girl who would be a sufficient attraction for any summer resort. She is asking: "Where shall I go this summer," and all who see the picture will wish they knew. The book is full of descriptive and interesting matter, and it is certain that one would make no mistake to go to most any of these places from Old Point Comfort way back to the mountains. Sea and trout fishing, hunting, driving and bicycling, can be had to the fill. There is only one mistake in the book. Three old 10 inch Rodman guns on the parapet of Fortress Monroe are labelled, "some of the modern guns," but the average reader won't know the difference. The S. A. L., under the energetic management of Mr. E. St. John, has stepped right up to the front rank of railroads. Send for the book.

A new mountain railway is being built in the Carinthian Alps from Heiligenblut, the highest village in the Austrian Alps, to the Mountain House on the Grossglockner. The road, which is but four and a half miles long, has to ascend fully 2,725 feet from end to end, and the grade varies from 40 feet per 1,000 to 29 feet per 100. The motor system adopted for the railroad is a combined tooth rack and electric surface railway.

RELATIONS BETWEEN BOILERS, CYLINDERS AND WEIGHT ON DRIVING WHEELS OF LOCOMOTIVES.*

(*Continued from page 325.*)

MAURICE DEMOULIN.

The power of a locomotive is seldom reckoned in horse-power, which must, it seems, be attributed to the extreme variations of this power not less than to the difficulty of calculating exactly the foot-lbs. of work necessary for drawing a given train at a given speed, and the difficulty of taking indicator diagrams from these engines, and also to the small value of the calculation from the point of view of actual working.

The marine engine produces a definite power which is perfectly constant as long as the speed is so; there is no other way of measuring the work developed than by taking diagrams. Its power expressed in "Horse Power" is the only means of comparison which the engineer has in this case. It is very much the same with stationary engines, but one can also easily measure their brake horse-power if they are not too large for the ordinary methods.

For the locomotive on the contrary what is the real meaning of the calculated horse power? What idea does it give of the actual work which the engine is able to do? What relation is there between the horse-power, the speed and the weight of train which the engine will draw? At most it only indicates what the engine is capable of doing at a given moment, and often only for a very short time. An engine which could not develop a mean horse-power greater than 500 might be capable under such circumstances of doing 800 or 1,000 for a few moments. Could one call this maximum power the power of the engine?

The same difficulty does not exist for other steam engines, because a definite power corresponds with a given number of revolutions. For example, in marine engines the power depends simply on the number of revolutions, and the draft of water. But in the case of the locomotives, the speed alone means nothing, the load and the gradient, always varying, two factors no less important. One can only establish a relation between the speed and the power, for engines pulling a standard train of fixed weight on a uniform gradient.

A locomotive drawing a definite load on the level presents an interesting peculiarity, namely that corresponding with the maximum power developed, the pressure in the cylinders is a minimum, and so also is the tractive force, and vice versa. Thus at the moment of starting, the pressure on the piston and the pull on the draw-bar are maxima, but the consumption of steam is very small; as the speed increases, the tractive force diminishes, but the steam consumption and the power increase. In other words, the the work per revolution diminishes, but the number of revolutions increases at a faster rate, and thus the total power increases. In one word the product PS, increases much less fast than S, because P diminishes as S increases, but at a slower rate. If now we consider trains of different speeds and weights, we shall find that there is for every locomotive a maximum power which can be developed at different speeds, either with a train of weight W, at a speed s, or with a train of weight w at a speed S, but that is only true beyond a certain value of s. An express locomotive for example, drawing at low speed a goods train of great weight relatively to the adhesive weight of the engine, might develop less power than it would when drawing a lighter train at high speed over the same line. On the other hand, there are intermediate speeds and loads for which the power would also be maximum. In a word, at all speeds between the limits S and s but only between these limits, there is a corresponding weight of load xw which will allow the engine to develop its maximum power. Between these limits, sufficiently narrow however, the power might be the maximum for all values of the speed. For a speed less than s on the contrary, there is no load which will allow the locomotive to develop its maximum power; for when using its maximum adhesion at a slow speed the power developed is less than that when much less adhesion is required at a higher speed.

The variations in the gradient do not really form a special case, because they correspond to changes in the tractive force, and have the same results as equivalent changes in the load. If the gradient is very steep the tractive force would be very great, and the speed small, just as in the former case. The power developed by the engine in running up this gradient will not be its maximum, unless the gradient is sufficiently slight to allow the speed to be greater than that which we have above called s.

The reduction of the tractive force as the speed increases, even assuming that the boiler has unlimited steaming power, is due, as is well known, to the fact that the wire-drawing of the steam, and the increase of back pressure at high speeds reduce the mean effective pressure on the piston; for lower speeds the greater mean effective pressure compensates entirely or in part for the smaller number of revolutions. If one left an engine to itself after starting it with a very light train, even assuming that the boiler was sufficiently large, the speed would soon attain a maximum which could not be passed. If in fact the volume of the cylinders, designed in order to insure the necessary tractive force at starting, is too large for the normal work which has to be done at full speed, yet the steam passages, calculated for the maximum flow at a slow speed and often reduced for want of room would soon become insufficient as the number of revolutions increased.

Wire-drawing reduces the pressure on the active side of the piston while the choking of the exhaust increases the back pressure on the other side, which diminishes the mean effective pressure, and the work done per revolution. Yet we have seen that the power developed increases with the speed, because the latter increases faster than the effective pressure diminishes. The actual steam admission, therefore at even quite moderate speeds is always less than the nominal admission corresponding to the position of the regulator. A first loss occurs between the boiler and the valve chest, owing to the friction through the orifices of the regulator, and in the bends of the steam pipe. A second loss, generally more important, occurs during admission between the valve chest and the cylinder. Owing to this latter the actual quantity of steam used is much less than that corresponding to the point of cut-off indicated by the position of the link, and this effect is greater the higher the speed. At a speed of 56 miles (90 kilometers) a cut off of 30 p. c. often gives less steam per stroke of the piston than a cut off of 12 or 15 p. c. at a speed of 12½ miles (20 kilometres). If one does not modify the cylinders of a locomotive or at any rate their steam passages, it will be useless after a certain limit to increase the power of the boiler, because the cylinders will not be able to take the steam produced.

One would ot be able to make use of the increase of steam production to increase the steam admission because the section of the admission ports and above all of the exhaust would be much too small for the speeds in question.

The driver observes sometimes when his engine is already running at a considerable speed, that a wider opening of the regulator implies a reduction in speed, instead of the increase on which he counted.

This fact, paradoxical as it appears, is well known, and is due as is known to the insufficient section of the exhaust, all the more noticeable at high speeds because the motion is usually notched up, and the travel of the valves much reduced and the period of exhaust made shorter.

The power of the engine at high speeds is thus found to be limited, even when the power of the boiler is sufficient. Yet up to the present time there has been no object in increasing the section of the steam passages, because the limit which they impose on the power is practically the same as that due to the boilers actually used, and the speeds usually obtained.

At the moment of starting, the locomotive has to overcome the initial friction, and the inertia of the train, and has therefore need of all its adhesion. On the other hand, a considerable part of this becomes useless when the train is once started, and at a certain speed, which is different according to the type of engine, the weight of the train, and the atmospheric conditions, one might uncouple a pair of wheels without causing slipping, the diminution of the mean effective pressure on the piston and of the work per revolution no longer allowing the whole adhesive weight to be used. These considerations justifiy the use of express engines with single wheels for trains with few stops, when the load on the driving axle can be

made large enough to insure starting with the help of the steam sand jet.

The larger the proportion of its adhesion which a locomotive can use after starting, that is the larger the proportion of its boiler to its cylinders, the larger the load which it will be able to draw at a given speed, or, which comes to the same thing, the greater will be the speed at which it can draw a train of given weight. To sum up, if the tractive effort exerted at the moment of starting is independent of the heating surface and grate area, it is quite otherwise with the tractive force exerted when the train is in movement, because one has no longer to consider a static force, but work. The increase in the speeds of trains makes it more and more necessary to use engines capable of exerting at high speeds a larger proportion of their initial tractive force.

This result is obtained by increasing the size of the boilers further and further for a given effective weight and volume of cylinder, which allows the number of strokes of the piston per unit of time to be increased, or at constant speed, the mean pressure on the pistons.

Now a locomotive the whole weight of which is effective for adhesion, and for which the size of the boiler is limited by the necessity not to overload the axles, will find its tractive force diminish continuously and rapidly from S =O to S=maximum. If, on the other hand, we add to the engine one or two carrying axles, we may increase the volume of the boiler compared with the cylinders, and consequently use at full speed a larger fraction of the effective weight. For equal effective weights, the engine, with one or more uncoupled axles, will be more powerful than the engine whose whole weight is on the driving wheels, and will start quicker and maintain a higher speed with a given train. If the addition of the extra axle is made partly at the expense of the adhesive weight the engine will not be able at starting to exert so large a force—which, however, can be remedied by the steam sanding apparatus—but since we assume that the boiler is larger, it will soon assert its superiority, and at a definite moderate speed it will be equal to the other, and at a higher speed it will draw a heavier load. Many engines, part of whose weight only is effective, especially engines with single driving wheels, of course with powerful boilers, and which are unable to start a train of weight w without the sand jet, are able to draw at full speed, which may be very high, a train weighing $w + x$.

It is clear that the higher the average running speed becomes, the higher must be the ratio of the heating surface and grate area to the volume of the cylinders, or for the proportions usually adopted, the higher must be their ratio to the adhesive weight. At one end of the series we find the slow speed locomotive with 8 or 10 wheels all coupled; at the other end, the locomotives with single drivers, for express service, so much used in England, and which for an adhesive weight not greater than 18 tons have boilers of the same size as the engines with 4 wheels coupled with a greater adhesive weight, but used to draw slower trains, or as the still slower goods engines whose adhesive weight is more than double. We must admit then that these engines develop practically the same mean power, that is that the product of the tractive force and average speed is constant. We must consider as exceptional large goods locomotives or engines for heavy gradients.

It is true that it may be objected that it is nevertheless advantageous to employ coupled engines with their whole weight on the driving wheels, even for fast goods trains because if there be excessive adherence after the train has started, there is no objection in that, and it may, on the other hand, be found useful at starting. This objection is certainly well founded, but as soon as the effective weight is made sufficient to start the load which the engine is able to draw at the required speed, the replacing of a coupled axle by a radial carrying axle or bogie has the advantage of doing away with two coupling rods, of allowing the overhang in front to be diminished, and further of giving more flexibility to the engine.

The more frequent use in Europe and more especially in the United States of engines with 6 wheels coupled and a bogie for heavy fast trains, a type of engine so satisfactory and whose principle is so contrary to the old theories, shows clearly the new requirements which have arisen from the increase in the speed of goods trains, and in the weight of passenger trains.

Formerly railway engineers endeavored to increase the effective weight, witness the tank-engines, of the Eastern of France and Great Northern Companies; nowadays they are more anxious to increase the power of the boilers because it is not merely a question of starting heavy trains, but also of hauling them at a higher mean speed. They would be more likely to mount on the tender a second boiler than to put on it cylinders supplied with steam from the ordinary locomotive boiler.

The increase of the heating surface and grate area beyond a certain limit will not always, as we have seen, have the desired effect of increasing the power and speed, unless the area of the steam passages is also increased, so that the friction in the passages being lessened the cylinders may be capable of using all the steam supplied by the boiler. The mean effective pressure on the piston will thus be higher so that with cylinders of the same diameter and without too great a reduction of expansion, we can obtain more power. Besides, the increase in the volume of the cylinders is not what is wanted under the circumstances, because it is a question of increasing the speed and consequently the revolutions per minute, and not the force at starting or the power per revolution.

En resume, the evolution of the locomotive has taken place and continues to advance according to the requirements of the traffic. The increase in the weight of the trains resulted in the increase of effective weight, volume of the cylinders and grate area. The increase in the speeds has resulted in the increased ratio of grate area and heating surface to the adhesive weight. The faster the trains the greater, other things being equal, will this ratio be. This has already led at an early period to engines with all their weight on the driving wheels being abandoned for fast traffic, for their adhesive weight was superfluous after the start and consequently wasted, while it implied a number of coupled axles which are unsuitable for high speeds and reduce the flexibility of the locomotive.

Finally, the engineers had to go still further; in order to increase the size of the boiler both absolutely and relatively a new carrying axle was added, either placed behind the coupled wheels, or joined to an existing carrying wheel to form a bogie. The increase in the speed of goods trains has had a similar effect. The adhesive weight remaining the same, the size and weight of the boiler have been increased to the point of requiring, in certain 6 coupled engines (In the United States even 8 coupled engines) the addition of one or two carrying axles or of a leading bogie, in itself an advantage in view of stability.

In short, progress seems to consist in designing the engines in view of being able to use, at higher speeds, a larger and larger fraction of the adhesive weight or, what is in fact the same, to increase the absolute and relative production of their boilers.

CORROSION OF RAILS AND AIR BRAKE PIPES.

In the discussion of the report of the committee on the "Location of Air Brake Cylinders on Freight Cars," which was presented at the convention of the Master Car Builders' Association at Saratoga, explanations were asked of the committee as to the reasons for the recommendation for a change in the

FIG. 1.—CORRODED RAIL.

location of the cylinders and air pipes from the center of the car to the side, along the side sills. The report contains the following paragraph in this connection.

"The main air pipe should be located as near outside line of side sill as possible. This will enable the men to readily reach and clean the drain cups in the main air pipe and will also place the pipe in a position on gondola cars where the least possible injury will be caused by the dripping of water on the pipes after having passed through bituminous coal that cars may be loaded with."

That this recommendation was made with a purpose of obviating a real and not a fancied difficulty

FIG. 2.—CORRODED PIPES.

was shown by Mr. H. C. McCarthy of the Northern Central Railroad in the discussion, in placing upon record before the association photographs showing the effect of the leachings of sulphuric acid which had dripped upon a rail and upon the main air pipe of a car. By courtesy of Mr. McCarthy we are enabled to present the accompanying illustrations which point forcibly to the necessity for giving attention to the point mentioned in the report. Fig. 1 was taken from a photograph of a piece of 67 pound rail recently removed from a side track on the Philadelphia & Erie division of the Pennsylvania Railroad. The head was cut-off on one side, clear up to the web, the web itself had been made thinner and a considerable portion of the flange and also the top of the head of the rail were destroyed. This was caused by water dripping upon the rail from a car loaded with bituminous coal that had accidentally been allowed to stand upon the side track for a period of ten weeks during which time the rail was eaten away as shown.

The effect of similar action upon air brake pipes is clearly shown in Fig. 2 which presents a view of two pieces of air brake pipe which have been eaten entirely through by the leachings. The pipe was made thin for a space and in several other spots the material was cut almost entirely through. These illustrations of cases taken from actual practice show better than an indefinite statement could possibly do that there is need for care in preserving these pipes from such action.

LABORATORY TESTS OF BRAKE SHOES.*

It will be remembered that last year the committee in making its report showed a comparison of the results of different kinds of brake shoes tested when subjected to what was considered the representative conditions of freight and passenger service that might prevail on railroads in the United States, giving the actual retarding powers or coefficients of friction obtained. It was stated in the report that the results indicated that there was a variation in the coefficient of friction resulting from variations in speed and brake shoe pressure and it was thought desirable that this variation in the coefficient of friction should be known for the varying conditions of speed and pressure. In continuing the committee for another year, therefore, it was understood that these variations should be determined, and should constitute its principal work for the ensuing year. Your committee is glad to be able to report that it has accomplished this work, although there are a small number of results that could not be prepared in time to be included in this report, but which will be published with the annual report of the proceedings of the association for the year 1896.

In conducting this work, the committee found it necessary to repeat a large part of the work done last year, and it was found that the tests made of the same brake shoes under the same conditions gave results which checked very closely with those obtained last year, with the exception of the soft and hard steel shoes lettered "C" and "D," respectfully. The results of the tests of these two shoes this year show a somewhat higher coefficient of

Chemical analysis of samples of soft cast iron, hard cast iron, soft cast steel and hard cast steel, representing shoes "A," "B," "C" and "D," respectively.

Made by Dr. C. B. Dudley, Altoona, Pa.

	Carbon.	Phosphorus.	Manganese.	Silicon	Sulphur.
A 1	3.42	0.82	0.24	2.09	0.11
A 2	3.50	0.82	0.28	2.08	0.11
A 3	3.45	0181	0.27	2.04	0.11
B 1	3.82	0.42	0.41	0.78	0.17
B 2	3.72	0.43	0.36	0.75	0.15
B 3	3.76	0.43	0.35	0.75	0.16
C 1	0.27	0.04	0.04	0.21	0.03
C 2	0.28	0.04	0.64	0.21	0.03
C 3	0.27	0.04	0.67	0.20	0.03
D 1	0.25	0.08	0.56	0.22	0.00
D 2	0.27	0.08	0.56	0.23	0.06
D 3	0.25	0.08	0.55	0.22	0.06

Dynamometer drilling tests of samples of soft cast iron, hard cast iron, soft cast steel and hard cast steel, representing shoes "A," "B," "C" and "D" respectively.

Made by Prof. Wm. F. M. Goss, of Purdue University, LaFayette, Ind.

Foot pounds of energy required to remove one cubic inch:

A 1	39951.9	B 1	37317.7	C 1	72203.9	D 1	66738.8
A 2	37317.7	B 2	37756.7	C 2	72147.6	D 2	66879.2
A 3	38488.5	B 3	38781.2	C 3	72147.6	D 3	66879.2

TESTS OF IRON FOR BRAKE SHOES.

friction than last year's tests, due to the fact that the tests of last year were made directly after making tests of hard cast iron shoes, which left the surface of the wheel in a slightly rougher condition than was the case this year.

It should be here stated that shoes lettered "E," "F" and "G" (malleable iron) and "N" (Sargent special) were not tested this year, owing to the fact that the manufacturers did not care to continue their shoes in the test, for reasons best known to themselves, and did not wish to furnish samples for our work. The Sargent Co., however, furnished another shoe (lettered "R" in the report of this year) which it asked the committee to test, and the results are given in the diagrams accompany this report.

It should also be said that shoes lettered "K" in this year's report, while of the same construction as those tested and lettered "K" last year, had the metal changed from soft cast iron to hard cast iron, in order to prevent the frequent breakage experienced last year. By reference to the results it will be found that the "K" shoe of this year gives a slightly higher coefficient of friction than it did last, which is contrary to what might be expected, but the difficulty on account of breakage was not entirely overcome.

*Report of committee to the Master Mechanics' Association, June 17, 1696.

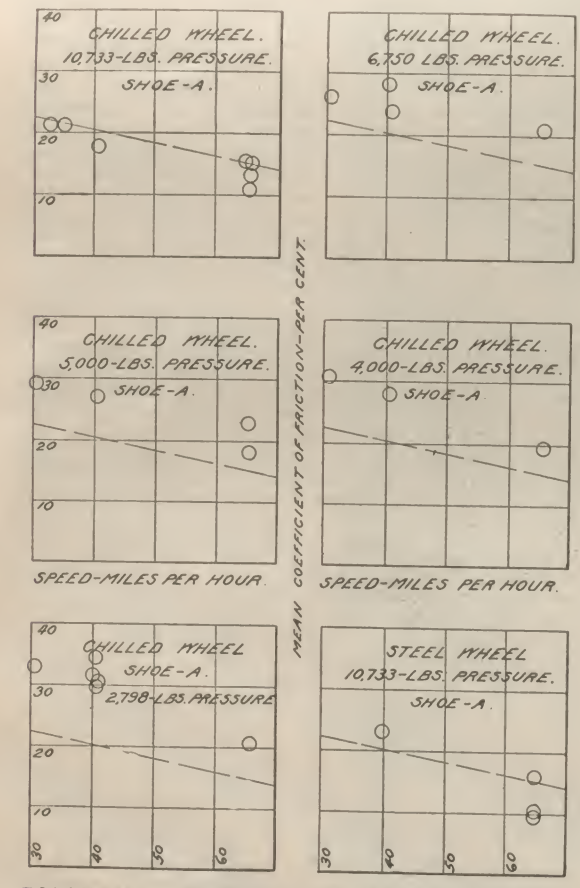
In order to present clearly the results of the work done this year, your committee has shown them by diagram instead of by tabulation; two sets of diagrams being given for all of the shoes:

First. Constant pressure at variable speed.

Second. Constant speed at variable pressure.

As cast iron is the material most generally used for brake shoes at the present time, and as soft cast iron gave nearly the highest coefficient of friction obtained last year, the results obtained with this shoe are used as the basis of comparison in the diagrams. (One set of these is shown in the accompanying diagram.—ED.) In the case of the constant pressure diagrams, the horizontal divisions or abscissae represent the speeds, and the vertical divisions, or ordinates, represent the coefficient of friction. In the constant speed diagrams the horizontal divisions represent pressure, and the vertical divisions the coefficient of friction. The first results given in each set of diagrams were those obtained with the cast iron shoe. Each small circle represents the average result of a series of tests (usually five) made under the same conditions, and the slope line drawn indicates the law of variation of the coefficient of friction of the cast iron shoe, as nearly as it is possible to arrive at it. This line is repeated in each diagram, in order that the law of variation of other shoes can be readily compared with that of cast iron.

From these results it will be found that with either an increased speed or an increased pressure, there is a decrease in the coefficient of friction, and that between the limits of minimum and maximum conditions of railway service, this variation in coefficient of friction is a very material one.



DIAGRAMS OF TESTS OF BRAKE SHOES.

From a careful perusal of the diagrams it will be found that in nearly all of the tests made of any one shoe under the same conditions of speed and load, somewhat different coefficients are given, but that in most cases the difference is not very great. These differences are due to variations in the surface of both the brake shoe and wheel that come as a result of rubbing against each other, and are fairly indicative of variations that might be expected in service in the case of successive applications of any brake shoe to the wheel to which it may be applied. It will be found, however, that with both increases in pressures and increases in speeds, a line can be drawn which will fairly represent the law for each particular shoe.

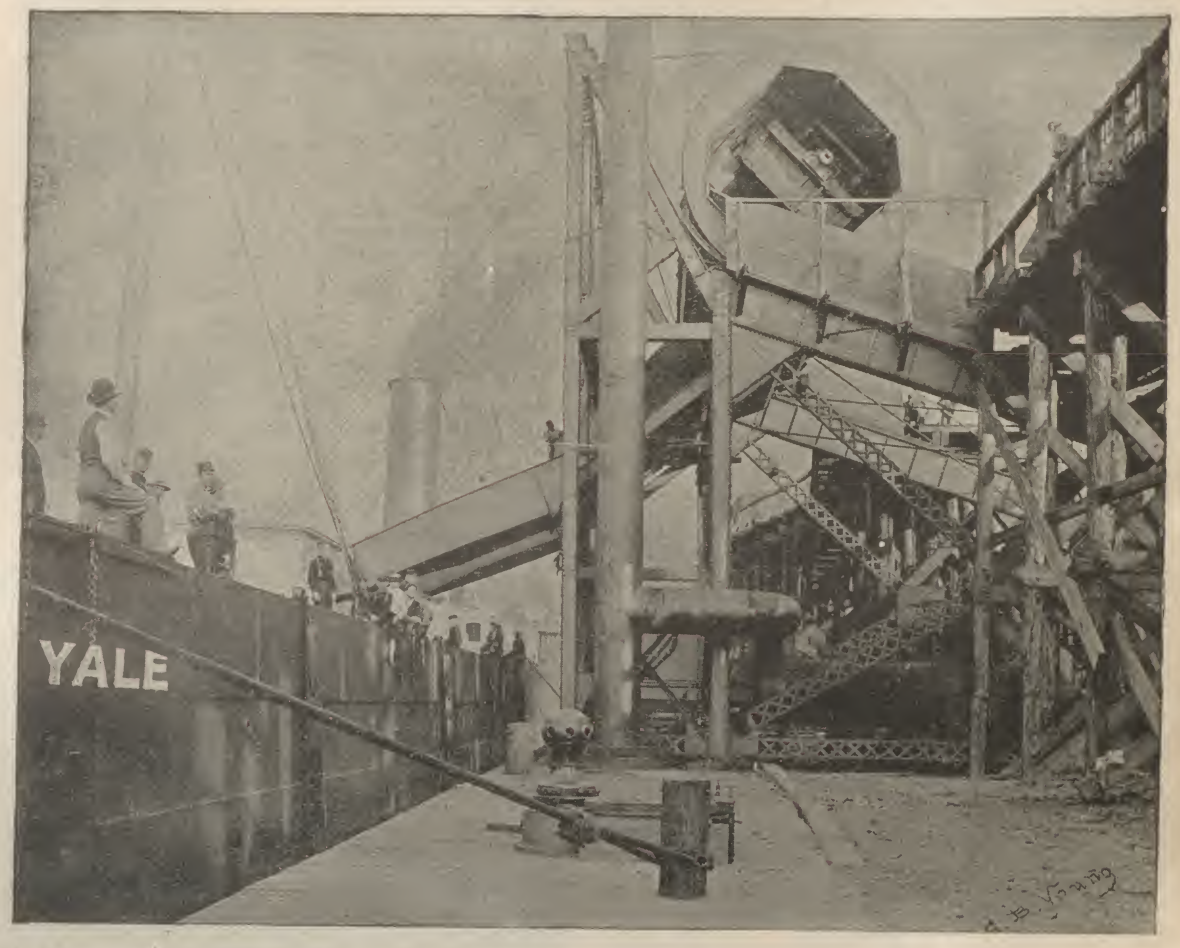
It should be here noted that these tests represent the conditions of a dry wheel and a dry shoe, and the highest coefficients are the results that were obtained under the most favorable conditions. The most favorable conditions include, in addition to a dry wheel and a dry shoe, smooth surfaces (the degree of which it would be impossible to describe).

As previously stated, the highest results obtained with the shoes lettered "C" and "D" this year, were somewhat higher than the results obtained with the same shoes last year, and the committee would state that the test of these shoes shows greater variation than any other.

In the early part of the present year it was thought that it would be well to make some tests with some shoes 17 in. long, also some tests with shoes covering the flange of the wheel, instead of the tread only. In the case of the former it was found impossible to obtain a full bearing of the shoe on the wheel, on account of the distortion of the shoe when heated by application, so that further tests were abandoned. It can be stated, however, that there is nothing to indicate that a 17-in. shoe will give any different results from the standard 13-in. shoe, except that which would come through difference in the pressure per unit of area, which difference is already shown fully by the variable pressure tests in the case of all the shoes. In the case of the flanged shoe it has been claimed that the friction would be increased by reason of a wedging action between that part of the shoe that bears on the flange and the flange. In attempting to make tests with this class of shoe it was found almost impossible to get a perfect bearing between the shoe and the wheel, without wearing the two together for a considerable period, but this was found to require so much time that it could not be undertaken except in the case of a cast iron shoe on a steel-tired wheel. The result of this test could not be worked up in time to be included in the printed report; the committee feels, however, that so far as friction is concerned there is no advantage in the flanged shoe, except that it increases the surfaces in contact, and thereby reduces the pressure per unit of area, the result of which is already shown by the variable pressure diagrams.

While conducting this work this year, the committee had requests from two or three manufacturers to test shoes of their production not heretofore tested, which it would have been glad to have done, had it not been for the limited time it had to complete the work already mapped out, but as it was, there was not sufficient time, and the best that could be done was to make a few tests that would be indicative of their relative values, which it did, and these results will be published in the report as it will appear in the proceedings of the convention. These shoes are known as the Corning, which could not be tested at all on account of being too hard to true up, and the Kinzer & Jones composition shoe.

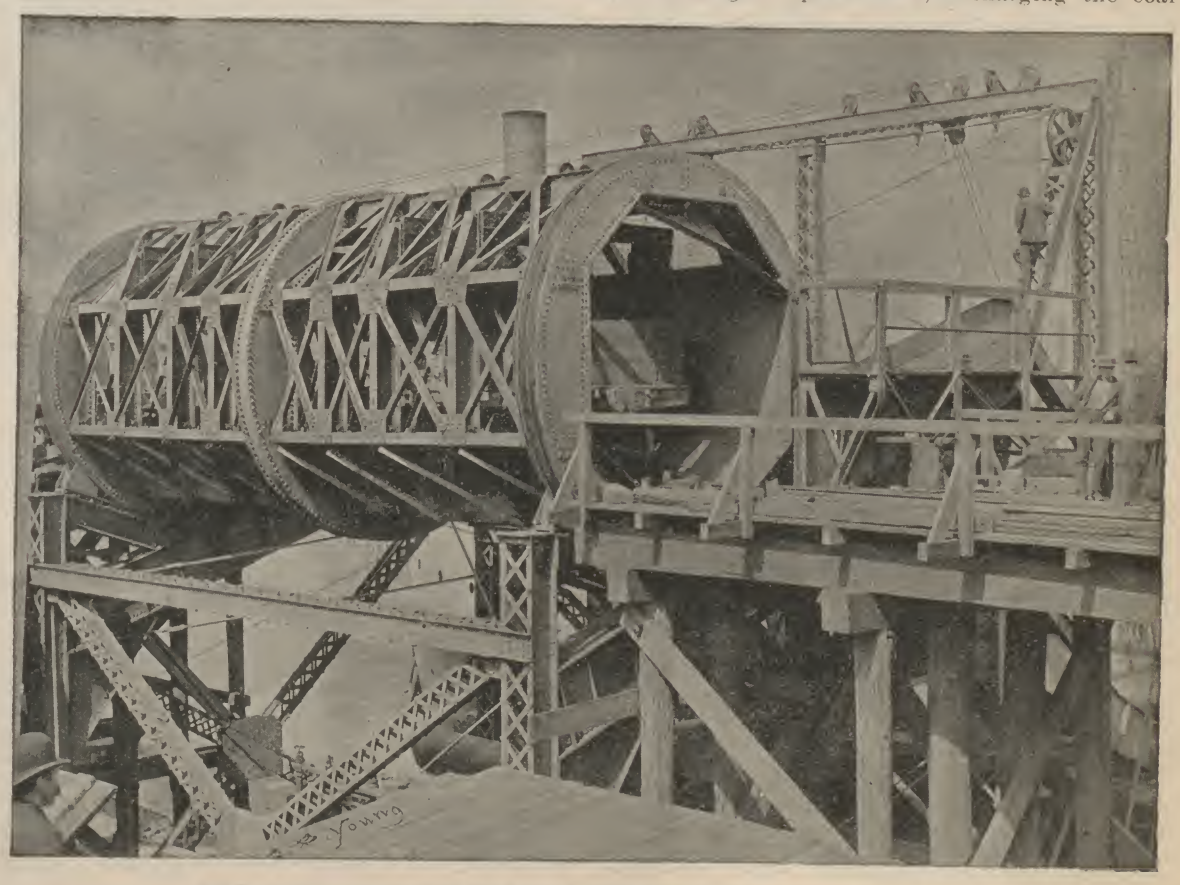
In conclusion the committee desires to say that it believes all of the important work has been done, and that the results are as satisfactory as it is possible to obtain. Results are shown which will be a true guide for any railroad company wishing to design brake gear for any equipment, or in deciding whether it would be safe and practicable to use any of the shoes tested.



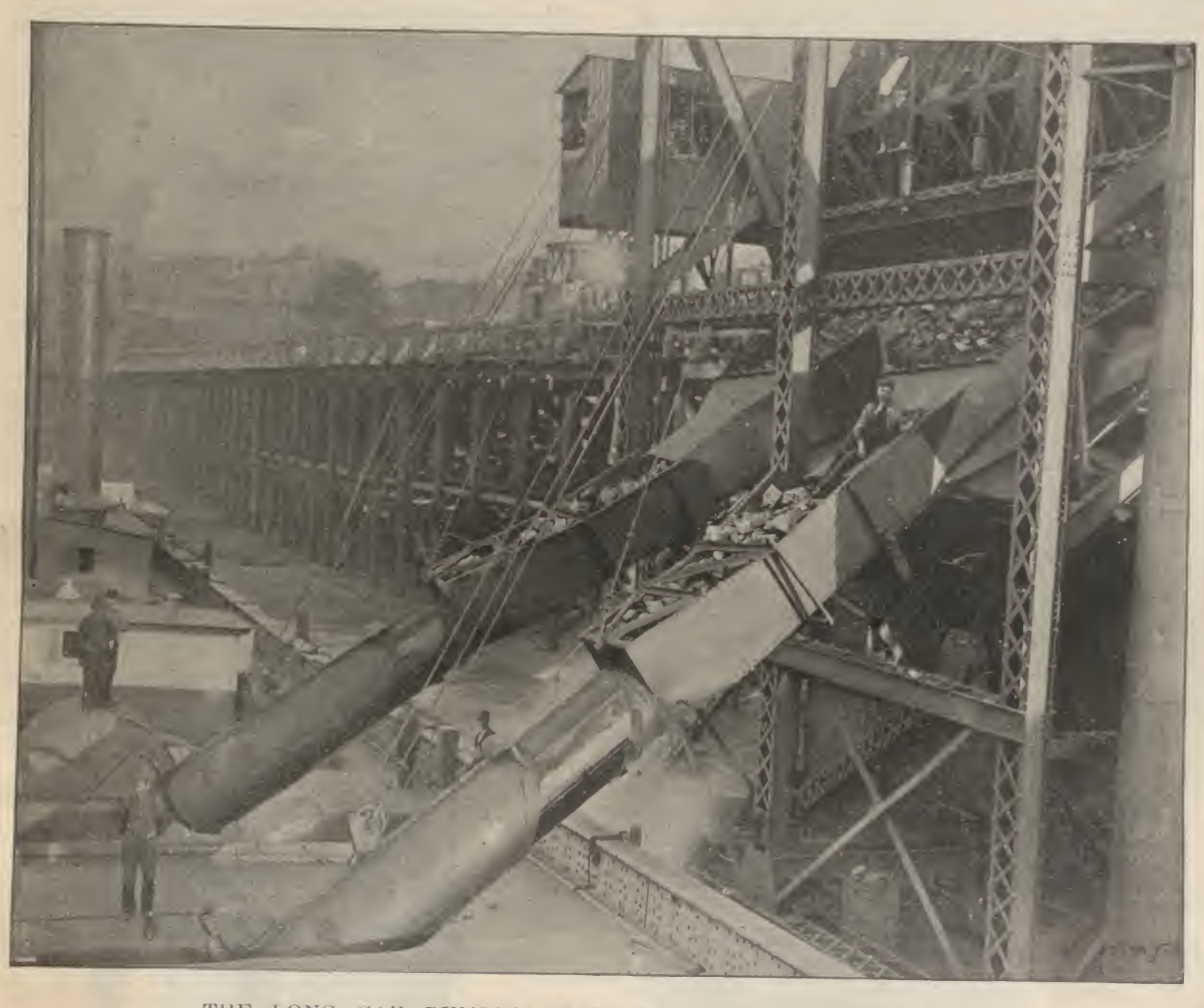
THE LONG CAR DUMPING MACHINE—FIG. 1.—GENERAL VIEW.

THE LONG CAR DUMPING MACHINE.

The accompanying illustrations show the appearance of the Long Car Dumping Machine which has been in use on the Erie Railway docks in Cleveland, Ohio, and has done some remarkably good work in loading vessels during the past two or three years. The essential feature of the machine is a large cylinder constructed for receiving a car filled with coal and turning it upside down, discharging the coal



THE LONG CAR DUMPING MACHINE—FIG. 2.—DUMPING CYLINDER.



THE LONG CAR DUMPING MACHINE.—FIG. 3.—TELESCOPE CHUTES.

into chutes which guide it into the hatchways of the vessels being loaded. The illustration, Fig. 1, is reproduced from a photograph showing a general view of the machine. Fig. 2 shows the cylinder with a car in place ready for dumping, and Fig. 3 shows the telescopic chutes filled with coal ready for discharging. The cylinder is 40 ft. long, has a clear internal diameter of 11 ft., an external diameter of 16 ft., weighs 40 tons, is constructed entirely of steel, and is supported at each end by two heavy steel T rails. The level of the railway tracks at the point where it was desired to locate the machine was about 28 ft. above the dock level, and therefore in order to meet these conditions the cylinder was supported on a steel superstructure and placed on a level with the existing tracks. This makes a practical and convenient plant, as the space beneath is an ideal location for the power plant and operating machinery.

The cylinder in dumping a car is simply rolled along its supporting track by means of wire ropes which are passed around its periphery. A double cable is used at each end of the cylinder, and after being passed around the cylinder is carried over sheaves and down to a steam cylinder 30 in. in diameter and 19 ft. long, which lies in a horizontal position at the base of the superstructure. This cylinder contains a piston which is, by means of a piston rod, attached to a cross-head which also carries the lower end of the cables referred to. Steam pipes are arranged for admitting steam to either end of the cylinder, but under ordinary conditions steam is applied only for dumping, as the track on which the dumping cylinder rolls is placed on an incline, and it will return to its normal position by gravity, and in so doing carry the piston and cables with it. Between the rails which form the track upon which the cylinder rolls there are a series of steel pins about 4 in. in diameter, which engage with a series of corresponding holes in the cylinder, thus insuring that the travel of the cylinder will be equal on both ends and also that there will be no slipping.

One of the neatest and most ingenious parts of the design of this apparatus is the arrangement for clamping a loaded car in position. This is done by means of a series of heavy clamps which are entirely automatic in their action and come down on top of the car immediately on the cylinder beginning to roll. These clamps are then locked in position by a ratchet and cannot be released until the cylinder has returned to its normal position. The machine is operated from a small platform located at one end, where both the apparatus and the vessel being loaded are in plain view. There are only two operating levers used. One of these controls the pair of hydraulic cylinders which are used in holding supports against the lower side of the car as it is being dumped. The other lever admits and discharges steam to the operating cylinder. This operating lever gives the operator absolute control of all motions of the cylinder and by simple manipulations of this he can roll a car load of coal which, together with the cylinder weighs about 80 tons, as though it were only a feather's weight.

An important feature of the apparatus is the telescope chutes shown in Fig. 3. One of the first and chief objections which is always brought against an apparatus such as this, is that the coal handled is badly broken and for this reason it is desirable to have the chutes so designed as to reduce this breakage to a minimum. It appears that the inventor of this machine has accomplished this result. The chutes are arranged on an angle of about 45 deg., so that the coal does not have a direct drop but slides down the incline at a speed which is not sufficiently great to break it. In order to still further avoid breakage, controling doors are arranged on the lower end of each chute, and before any coal is discharged these doors are closed tight, the chutes are then filled, and by means of the doors, the flow of coal is under absolute control. Each chute is supported by wide cables which are controlled by a pair of hoisting engines and operated from the same platform as the dumping apparatus. By means of these cables the chutes may be moved about and raised and lowered to any position allowed by the dimensions of the hatchways. It is stated that the operator has such control over these chutes that trimming is a comparatively simple and inexpensive operation.

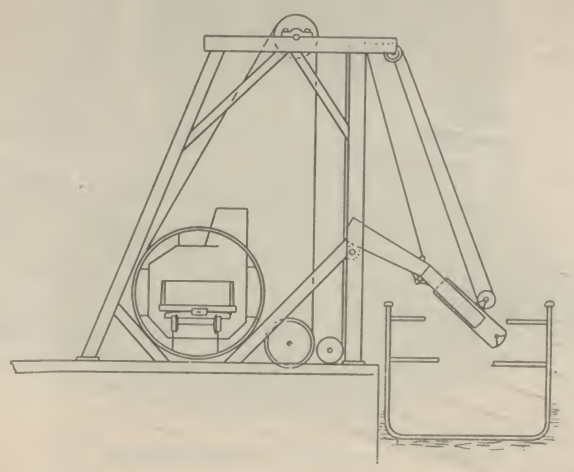


FIG. 4.—TAKING CAR FROM DOCK LEVEL.

Only three men are required for handling the entire machine. These are an engineer and fireman, both of these positions being filled by one man, one man to operate the cylinder and a third to control the movements of the chutes. It is claimed that the machine will handle 300 cars or 7,500 tons of coal in a day of 24 hours, and the reduction in the cost of loading vessels has been such as to almost revolutionize the coal business at the point where the machine is in operation. The machine is equally well adapted to use in taking cars from the dock level and dumping them into the hatchway of a vessel, and for locations where this is desirable, a general outline, such as that shown in Fig. 4 is used.

The machine was invented by Mr. Timothy Long, who has been for several years connected with the builders, the Excelsior Iron Works Co., of Cleveland, Ohio, of which Mr. George W. Short is president. This company has for several years past been one of the leading manufacturers of various kinds of coal handling machinery, and this machine is the result of a careful study of the subject by people who are thoroughly familiar with all its various phases.

CEMENT FROM BLAST FURNACE SLAG.

A series of experiments has been completed at the North Works of the Illinois Steel Co., in Chicago, upon the manufacture of cement from blast furnace slag, and the result is a new brand of cement which has every appearance of being equal to the best brands previously in use, either of foreign or domestic manufacture. The process by which this cement is made is so simple, and the results of the tests thus far conducted are so satisfactory, that the outlook for this material seems very promising. The idea of producing cement from slag is not by any means new. It has been manufactured abroad, in Germany, England, Belgium, Spain, and France for more than ten years, and although it very naturally has encountered serious opposition from the Portland cement manufacturers, still when made of slag of the proper composition, it has invariably stood the test of time very creditably alongside of Portland cements of the highest quality. An instance of this may be noted in the condition of the foundation of the German Parliament building at Berlin, which was constructed nearly ten years ago with cement manufactured from blast furnace slag. The serious opposition which slag cement has heretofore encountered was due mainly to two causes, first, its irregularity, and second, the fact that it was exceedingly slow in setting, requiring from five to twenty-four hours to harden.

Blast furnace slag is a very similar substance chemically to puzzolanic lavas, from which the famous old Roman cements were made. These have not been affected in their lasting qualities by the exposure of twenty centuries, as is indicated by the fact that the walls of the Coliseum at Rome, and of other celebrated buildings, are to-day in first class condition. While this new product has not been in use a sufficient length of time to obtain records of long standing, still there is nothing in its composition that would indicate possible deterioration, and up to the present time tests on the material show that it invariably increases in strength with its age, which leads to the conclusion that this cement like the Roman will stand the test of time.

The conditions of manufacture, which form a basis to this conclusion, are as follows: The materials from which the cement is made are staple in composition, and as each lot is accurately analyzed before being used, they must necessarily be chemically uniform and regular as well. The process of manufacture is purely mechanical and the product must necessarily be uniform in physical and chemical properties, and if of high quality once, it is safe to infer that it will be of high quality always. The fact that chemical reactions do not enter into the process is very important, as it removes the uncertainties of manufacture which are incident to any process which involve the subjection of the raw materials to intense heat. The burning of a Portland cement is in itself a most delicate operation, the proper manipulation of which determines largely the quality of the product. Slag cement requires no burning as the cintering of the elements together is accomplished in the blast furnace, and therefore this most common source of irregularity is avoided.

The process used by the Illinois Steel Co. is a strikingly simple one. The slag as it comes from the blast furnace flows into an open trough, which terminates above a large tank kept nearly full of water. Immediately beneath the end of the trough is a nozzle which is connected direct to a steam pump capable of throwing a large body of water against the

stream of molten slag at a pressure of 80 lbs. per square inch. This contact between the slag and the cold water causes the slag to break up or granulate into finely divided portions, the largest of which do not exceed the size of buck-shot. An excess of water is used in this operation, which leaves the slag in a moist condition, and the next operation is to dry out this moisture, which is done in a revolving drum, heated by the excess gas which is made in the blast furnace. Adjacent to this drum are large steel pans, heated on the under side by gas, in which the lime to be added is slacked and thoroughly dried. At this point in the process a small amount of a third substance is added which gives the cement its quick-setting qualities, and by varying the amount of this the time of setting may be regulated to a nicety. The slag and lime are then conveyed to a large hopper, which is set at an elevation, and from there they are fed in certain known proportions into a machine where they are intimately mixed and ground to an exceedingly fine condition. This machine consists of a horzontal cylinder about four feet in diameter and sixteen feet long, which revolves at a speed of about 24 revolutions per minute. This cylinder is half full of flint pebbles obtained from Norway, and the slag and lime is delivered to the cylinder through a trunnion at one end, coming at once among the pebbles and traveling the length of the cylinder until discharged from the periphery at the other extreme. The fineness of the product varies with the amount of material fed into the machine within a given time, and as this is entirely under control, the product may be brought to any degree of fineness desired. In fact upon this one point the good results of the cement are very largely dependent, and no product is shipped out which is not so fine that at least 95 per cent of it will pass through a standard sieve containing 40,000 meshes to the square inch.

The product which comes from the grinder is the finished cement, and is packed into barrels and bags for the market, emerging under the brand of "Steel Portland" cement. As above stated, the process of manufacture is in many respects like that employed by by the ancient Romans, who used lava that had run into the sea from volcanoes, and from the "trass" thus formed the cement was made by the mere addition of lime. These cements, as well as all other cements made from slag up to the present time have possessed the disadvantage of requiring a long time for setting, as previously stated This new process, however, admits to the manipulation of the material to any grade of time required for setting, ranging from 30 minutes to five hours. Another favorable feature of this cement is the entire absence of free quick lime, which substance acts to cause checking in cements where it is present. "Steel Portland" cement moreover is very light and uniform in color, and will not stain on exposure to the weather, but will retain its milk white appearance at all times. This is important in the use of cement for ornamental purposes.

On account of the great degree of fineness to which it is ground this cement does not show remarkably high tensile strength in the neat condition; but for the same reason it is correspondingly stronger than Portland cement when mixed with sand, the condition in which it is always used in practice. Some ideas of the strength qualities may be obtained from the examination of the accompanying table, the first set of figures being the results obtained from the tests made by the regular cement tester of the Illinois Steel Company, and the second set being those obtained on the material which has been examined by the engineer of the drainage board of Chicago. It should be remembered in examining the latter figures that the tests were made with the sand which is to be used in practice, while those made by the tester of the Illinois Steel Company were made with standard testing sand, or crushed quartz, which always shows higher results, but which is almost invariably used by engineers for testing purposes on account of its greater uniformity.

The practical results which have been obtained with this new material are quite as satisfactory as the laboratory tests. Samples of it have stood well in the ground through two of Chicago's most trying winters, and it has been used for many months in pit linings, sewers, and in foundations for engines and other highly important work. The Illinois Steel Company itself has been using it to the exclusion of all other high grade cements, which is a proof that they themselves feel confident of its lasting qualities. We are indebted to Mr. Jasper Whiting, superintendent of blast furnaces of the north works of the Illinois Steel Company, the patentee of the process, for this information and for an opportunity given a representative of this journal to inspect the works

RELATIVE STATEMENT SHOWING TESTS OF PORTLAND CEMENTS.

NEAT CEMENT.

Brand.	Tested by	Tensile Strength per Square Inch After: 24 hrs	7 d'ys	1 mo.	3 mos.	6 mos
Steel Portland..	Illinois Steel Co.		472.	505.		503.
" "	" " "		570.	653.		721.
" "	Drainage Board.	330.	416.	432.	480.	
Globe.....	Water Commissioners City of St. Louis.		438.4	607.	541.2	723.4
Alsen's.....			606.2	707.	756.	787.
Harris.....			599.4	647.6	681.8	752.4
Puzzolan.....			376.2	487.2	513.8	525.
Empire.....			691.2	871.6	819.8	819.8

Mixed with Sand in Proportion of one to three.

Brand.	Tested by	24 hrs	7 d'ys	1 mo.	3 mos	6 mos
Steel Portland..	Illinois Steel Co.		223.	280.		438.
" "	" " "		223.	343.		393.
" "	Drainage Board.		193.	238.	243.	
Globe.....	Water Commissioners City of St. Louis.		160.6	194.4	239.3	235.1
Alsen's.....			190.5	215.6	238.6	252.8
Harris.....			130.6	170.4	204.2	246.5
Puzzolan.....			163.3	210.	290.9	309.6
Empire			229.8	239.	299.6	358.9

THE STAR AIR COMPRESSOR.

The use of air which has of recent years become so extended about shops and particularly about railway shops, has awakened railway mechanical men to the necessity of keeping a good lookout in lines of engineering other than those relating directly to cars and locomotives. Those who have been doing this find themselves prepared and know just about what they should do in order to provide the shops under their charge with air, but those who are not posted make some bad blunders and have had to make changes in the original equipment they started out with.

In putting in a compressor plant there are many

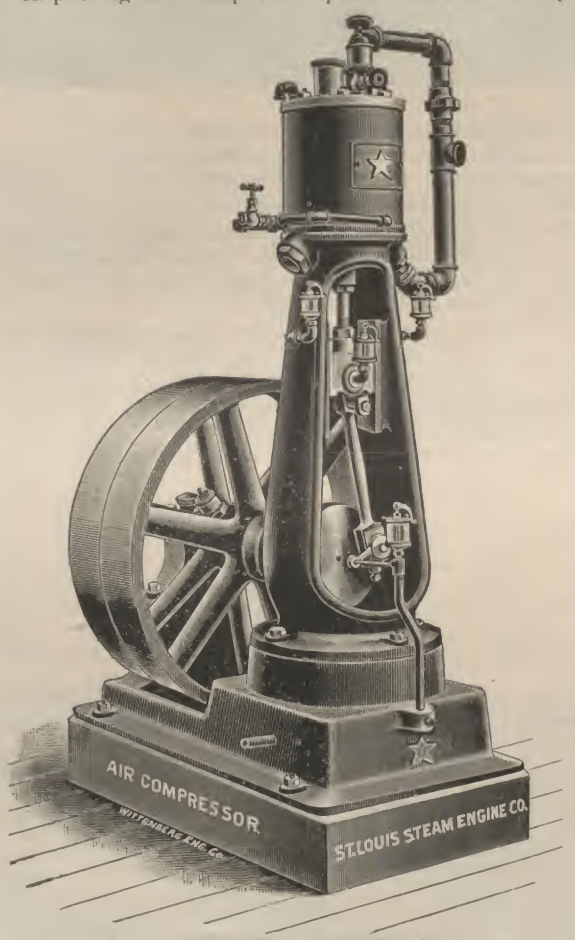


FIG. 1.—BELTED COMPRESSOR.

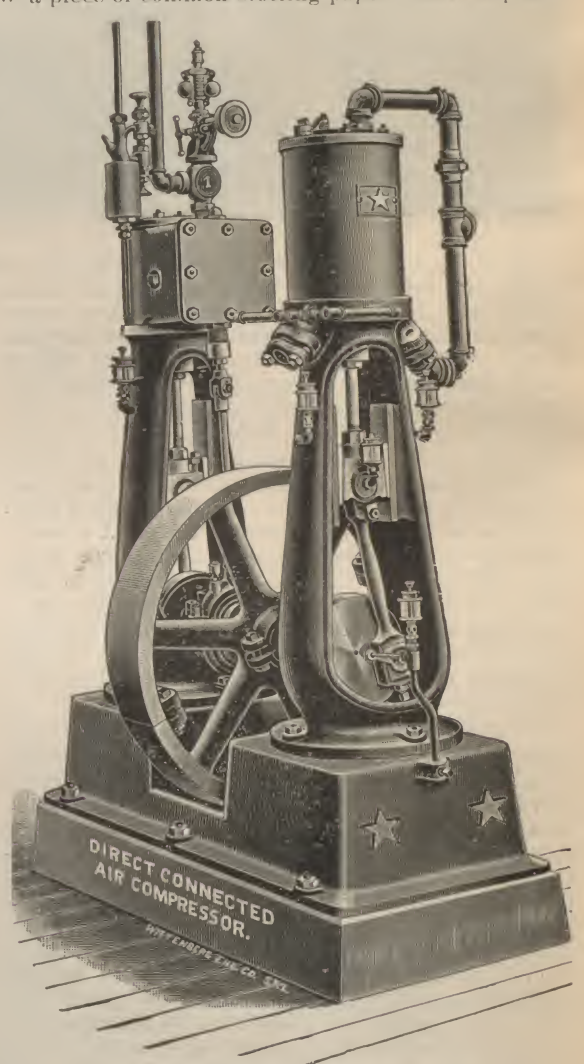


FIG. 2.—COUPLED COMPRESSOR.

things which must have consideration. Much depends on the care the plant will receive and many times the first cost is a great consideration. Where only a small sum is available for installing a plant, where the plant will not receive careful attention from a skilled engineer, or where only a small amount of air is required, the machines shown in the accompanying illustrations have many advantages. In these illustrations Fig. 1 shows a belted compressor which is made in three sizes having cylinders 6 x 6 in., 7 x 7 in., and 8 x 8 in., and capable of furnishing 25, 40 and 60 cu. ft. of air respectively per minute. The machines weigh 1,100, 1,700 and 2,400 lbs. respectively, occupy a small amount of space and are convenient and reliable machines for use where belt power is obtainable and a pressure of from 25 to 75 lbs per square inch is desired. Fig. 2 shows the same compressor coupled direct to an upright steam engine having cylinders the same size as the air cylinders of the compressor. Fig. 3 shows a machine having the same size cylinders with the air cylinder on top of the steam, and Fig. 4 shows the same type having two steam and two air cylinders.

The steam engines which are used are of the most simple design, having the bed and cylinder cast in one piece, the cylinder and guides being bored out and the bottom of the bed faced off at one setting, which insures a perfect alignment of all the vital parts. The connecting rod is of cast steel with solid ends slotted out for brass boxes, a convenient means for taking up wear on the pins, which are made of machine steel. The eccentric rod and valve stem are in line, which does away with the use of a valve stem slide, or what is worse, a bent eccentric rod, and in their stead a valve stem guide in top of steam chest is used. As the engines are designed for heavy duty and continuous running, they are provided with sight feed oil cups throughout, sight feed lubricator and a standard make of governor. The engine is also provided with a center or stationary crank pin oiler, which a great improvement over the usual practice of screwing an oil cup into the connecting rod.

All parts of the air compressors are as far as is possible made exact duplicates of those of the engine, so the cranks, connecting rods, cross-heads, etc., are interchangeable. Both heads as well as the body of the cylinder are provided with a water jacket and the valves and seats can easily be removed by simply breaking the pipe connections and without interfering with any other part of the machine. These valves are simple in design, sure in action and do not increase the clearance above what is necessery to prevent striking, and as that is reduced to the thickness of a piece of common blotting paper there is practically no loss from this source. Metallic packing rings are used which allows the cylinders to be lubricated for preventing excessive wear. The compressors can also be used as vacuum pumps and in this service have given 26 in. of vacuum in regular service. The cranks of the engine and air compressor are set about quartering on the shaft so that the engine develops its maximum power just at the moment the compressor requires the most power, and the fly wheel is not entirely depended upon for carrying it past this point. These machines are built by the St. Louis Steam Engine Co., of St. Louis, Mo., which company will be pleased to give any further information desired concerning them.

PASSENGER CAR ENDS AND PLATFORMS.*

It has given this matter very careful consideration and has prepared several drawings of platforms representing various modes of construction and also ends of cars, combining all the best features now in use. It now submits to the association a drawing (not reproduced here) of a con-

*Report of committee to the Master Car Builders' Association, June 17, 1896.

struction that it considers a combination of the best practices now in use, with some additional improvements in same, for your consideration; but your committee, after careful investigation, has every reason to believe that this construction infringes patents now in use; therefore, it is not in position to recommend that it be adopted as a recommended practice of this association.

The drawing shows the side sills reinforced by ½ x 7 in. iron plates placed between the side sill and a 2 in. sub sill, and the same thickness of plate placed between the center sill and the 2½ inch sub sill, each extending back to the tie timber and bolted together in the same manner.

The end sill is made 8 x 8 in., with ¾ x 3½ x 7 in. angle iron placed between the wood and bolted together.

The corners at end and side sills are secured together with ¾x7 in wrought iron corner bands and ¾ in. bolts. The center sill plate is flanged against end sill and secured in same manner. The end wall framing is reinforced by ½x2x3¼ in. angle irons, which are flanged to end sill and end plate, and part of the angle iron extending down, connecting the angle irons on the posts to same on end sill and end plate, making a continuous iron frame on end of car. The vertical tie rods are used in the usual manner to secure the end plate to end sill.

The committee would call attention to the fact that this construction makes a solid iron frame for end of car, each piece being secured to the other, forming one continuous iron frame. The platform and arrangement of buffer

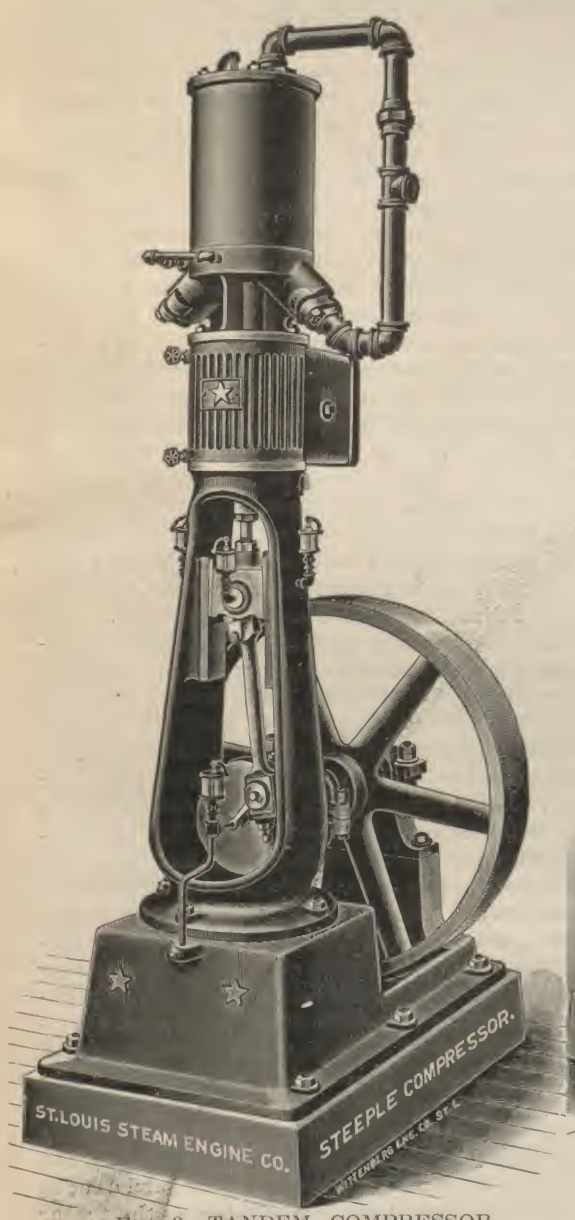


FIG. 3.—TANDEM COMPRESSOR.

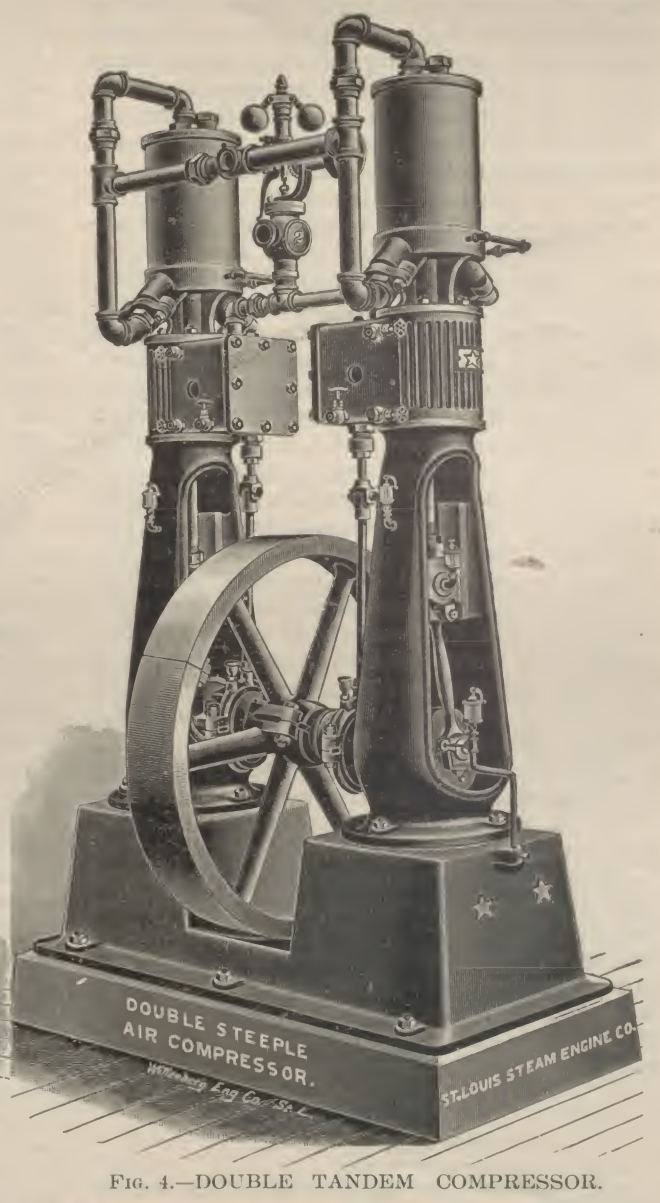


FIG. 4.—DOUBLE TANDEM COMPRESSOR.

plates, springs, etc., are familiar constructions and are a combination of different platforms now in use, the main feature being that the retaining springs are for the purpose of keeping the buffer and springs in position when not in contact with another car, and the use of the combination malleable iron cross-head guide and buffer spring casting, which abuts against the end sill. Another feature of this platform is the arrangement of draft springs and the use of cast steel follower carry iron and double pockets, which in connection with the followers, tail pins and spring pockets, allows the use of two draft springs, thus doubling the capacity of springs without increasing the deflection. The coupler stirrup is also somewhat improved in that it has a very large opening for coupler, which allows sufficient movement to overcome any transverse strains on the platform timbers, the coupler being held in alignment by side springs. The coupler stirrups have enlarged ends and are secured to end sill with two 1 in. rods. The draft timbers and platform timbers are plated with ½ in. iron, which extends the full length of timbers.

The impact required to make a coupling between two cars is exerted only on a small center and two side buffer springs which are calculated to have a capacity of 13,700 lbs., while any other compression after the cars are coupled will go to the buffer springs, having a total capacity of 25,700 lbs. Any compression, when the cars are coupled, would also go on the draft springs through the coupler, and the draft springs would have a capacity of 32,400 lbs., and this combined with the buffer springs gives the total buffing spring capacity of 58,100 lbs. The working load of this spring, however, is only about one-half of these figures, or 29,050 lbs.

The push-bar is attached to the coupler at the tail pin connecting with cross-head at back of center buffing springs, thus transmitting the draft strains to the buffer springs, keeping the buffers always in contact when cars are coupled together.

Your committee regrets that it cannot offer the association a construction that would not infringe any valid patents, but it has the consciousness of knowing that it has done the best it could under the circumstances.

THE STENCILING OF CARS.*

The committee to which the communication from the Car Inspectors' Association of North America recommending for the facilitating of work of inspection, that all car owners be requested to stencil hight and width of all high cars on the side of the car, and also that car owners be required to stencil size of journal on truck planks; also the numbers and initials of all box cars on floor timbers between cross-tie timbers, made the following report:

Communication with the secretary of the Car Inspectors' Association develops that the reasons for requesting the adoption of their recommendations are:

1. To expedite the movement of freight, especially at night, when it is difficult to read the car numbers and initials where they are located high up on car side.

2. To save loss of time in having to measure unusually large cars in order to know whether they will properly clear bridges, tunnels, etc., on the receiving company's lines.

3. To facilitate movements of inspectors in ascertaining proper size of journal bearings or axles in connection with repairs.

Your committee wishes to commend the spirit of interest in the improvement of service shown by the action of the Car Inspectors' Association, and we believe the suggestions made are good ones and worthy of having the general approval of the M. C. B. Association.

There are some difficulties in the way of carrying out literally the proposed stenciling on account of the different contour lines of high cars, and from the fact that some special classes of cars are sheathed over underneath, covering in the sills and floor timbers.

We believe, on the other hand, that the recommendations of the Car Inspectors' Association do not go quite far enough in attaining the desired smoothness in handling inspection work at interchange points. Oftentimes it is impossible for inspectors to tell, in connection with some of the prominent and expensive features of the cars, what is the proper standard. It would seem, to your committee, desirable to a limited extent, to cover these points by proper stenciling. Your committee would, therefore, recommend:

1. That on all box cars standing more than twelve feet from top of rail to eaves, the width at eaves be stenciled in 3 in. letters on side of car, as near the bottom as convenient.

2. That all box, stock and other roofed cars have the number and initials stenciled in 3 in. letters on outer face of outer floor timber between cross-tie timbers, except where cars are sealed over underneath, in which case the stenciling shall be put on inside face of each cross-tie timber in center.

3. That all classes of cars have style of coupler and rear attachments, and style of brake beams stenciled in not less than 1½ in. letters near one end of car on each side, or on each end of car directly above the buffer blocks where design of car permits it.

4. That where the construction of truck permits, truck, shall be stenciled on each side, giving the size of journals and the letters "M. C. B." if the axle is M. C. B. standard axle. If the axle is not M. C. B. standard use dimensions from center to center of journal in place of M. C. B. This stenciling to be in 1¼ in. letters, and to be put on end or side of bolster in Diamond trucks, and on side truck frame in center on Fox trucks.

5. That on all cars equipped with air brakes the words "air brake" in letters not less than 3 in. high, be stenciled on the sides or ends of the cars, and that the make of air brake equipment be stenciled (in smaller letters if desired) over or just preceding these words, to enable inspectors to detect repairs made with wrong material.

*Report of committee to the Master Car Builders' Association, June 17, 1896.

MALLEABLE IRON COUPLERS UNDER THE DROP.

In the RAILWAY REVIEW of June 6 of the current volume an account was given of a series of tests made by a representative of Messrs. R. W. Hunt & Company of Chicago upon a lot of American couplers made by the Whiteley Malleable Castings Company of Muncie, Ind. A statement has just been received from the latter concern recording another series of tests which are equally good. These tests were made on fourteen malleable iron couplers of the same type and manufacture as the lot previously noticed, which were taken from a shipment of one thousand couplers which were ready for delivery. The tests were conducted at the Whiteley Company's works by I. G. Reading, who represented Messrs. R. W. Hunt & Company. The Master Car Builders' specifications require couplers to withstand three blows at ten feet and two blows at fifteen feet, using a standard 1,640 lb. hammer. These couplers averaged three blows at ten feet and over seven blows at fifteen feet, as will be seen by an examination of the following record of the tests, which were made June 30, 1896:

No. 1, 3 blows at 10 ft., 6 blows at 15 ft.—Bar bent but not broken; fracture good.

No. 2, 3 blows at 10 ft., 8 blows at 15 ft.—Bar cracked in liner block, not broken; fracture good.

No. 3, 3 blows at 10 ft., 7 blows at 15 ft.—Knuckle broke.

No. 4, 3 blows at 10 ft., 5 blows at 15 ft.—Knuckle broke.

No. 5, 3 blows at 10 ft., 5 blows at 15 ft.—Head broke out at back wall; fracture good.

No. 6, 3 blows at 10 ft., 7 blows at 15 ft.—Stem broke under head; fracture good.

No. 7, 3 blows at 10 ft., 7 blows at 15 ft.—Head broke off under stem; fracture good.

No. 8, 3 blows at 10 ft., 7 blows at 15 ft.—Stem broken; fracture good.

No. 9, 3 blows at 10 ft., 7 blows at 15 ft.—Split through liner block, head not broken; fracture good.

No. 10, 3 blows at 10 ft., 6 blows at 15 ft.—Split through liner block; fracture good.

No. 11, 3 blows at 10 ft., 10 blows at 15 ft.—Stem broken under head; fracture good.

No. 12, 3 blows at 10 ft., 10 blows at 15 ft.—Broken at liner block; fracture good.

No. 13, 3 blows at 10 ft., 6 blows at 15 ft.—Broken at liner block; fracture good.

No. 14, 3 blows at 10 ft., 8 blows at 15 ft.—Liner block cracked, bar not broken; fracture good.

The Blue Book of American Shipping, recently published by the Marine Review Cleveland O., is a handsome volume of 325 pages that has two valuable features. One is that it combines in compact form all available information of the shipping and shipbuilding business of the great lakes, giving cost of operating lake steamers, and their performance in a mechanical line. This Blue Book contains over 7,500 names of ship owners and builders ship masters and engineers and the lists of owners has been so classified that 600 names include the owners of 3,000 of the largest freight and passenger vessels of the United States. Captains of lake steamers will find some sixteen pages of valuable information in the volume. One feature is the width of openings in draw bridges. Some of the new 48 feet beam steel ore carriers will not go through many of the bridges in different lake ports. In addition to the three chromo type inserts, there are over 40 pages of illustrations, showing modern lake steamers, dock equipment, etc.

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CHICAGO, SATURDAY, JULY 4, 1896.

THE iron and steel makers who usually supply railways with material and equipment profess to be informed that there will be considerable expenditure by the trunk lines east and was during the fall months for tracks and rolling stock. The intentions exist but will they be carried out? Were the railroads to reach their normal consumption, steel makers would prosper. Even as it is, repairing requirements compensate very largely for lack of old time railroad building requirements. The developments of the past month have been important. Prices are weak, demand fluctuating. Some products are protected by agreements while others are not. Bessemer and billets are neglected. Lake ore shipments are a little ahead of last year. Rumors prevail again of a possible break in coke. Considerable bridge building work will be entered upon by the early fall. Several construction requirements will expand somewhat, but without sufficient encouragement. It would seem rolls have been added, furnaces put in, plants increased and capacity enlarged to a degree that is calculated to arouse apprehension as to the safety of many producers.

IT was particularly noticeable in the recent convention of the Master Mechanics' Association that the method of preparing committee reports based upon replies to circulars of inquiry is very nearly a failure as it is at present conducted. The object of this plan is to present to the association recommendations founded upon a compilation of the practice of all of the members. The circulars of inquiry go to all of the members and if they were answered by all or even by a majority the recommendations might have the weight of the large amount of experience which is had upon the various roads represented. When only seven replies are returned, however, as was the case with one of the reports of this convention, a representatative recommendation is impossible. It is noticeable in this connection that sometimes valuable information is presented by members during the discussion of these reports at the meetings which the committee ought to have had to assist in the preparation of the report. This is not only discouraging to the committees but also prevents the members from obtaining some of the benefits which they should receive from the reports. This is probably the result of procrastination on the part of members, but however it comes about it should be given the necessary attention to secure complete and prompt replies to the circulars. Mr. Henderson's remark at the last meeting of the convention that a school in answering circulars should be opened for the benefit of the committees, should be taken in hand by many of the members.

IN glancing over the improvements in the construction of locomotives and cars which have been introduced during the past twenty years, one must be impressed with the evidences of study and experimentation on the part of some individuals who possess a deep interest in the development of new and improved methods. The question naturally comes to mind as to who has had sufficient interest in these matters to prompt the devotion necessary to bring the improvements to successful completion. It must be recognized that while the railways have contributed largely they are not to be credited with the larger part of these changes, but that men who may be called specialists in the design of rolling stock and its appurtenances and who are not connected with the staff of any road have done the most of it. These men have in nearly all cases, had practical railway experience which qualifies them to see and understand what the necessities are and they have sought to furnish that which was needed. They are not doing this good work without compensation but are looking to the roads for this important item. They are the men who are bringing out new trucks, new cars, new locomotives and parts thereof the presence of which are apparent to all concerned in transportation. They have done more than anyone else to assist in reducing the ratio of the dead to the paying load of freight equipment, they also have provided the means whereby high speeds are made safe and from the present indications they have much more work of this kind to produce in the near future. These improvements involve a great amount of experimental work, a large expenditure for engineering, heavy expense for the preparation for manufacture and for the protection of the rights vested in the invention of the new devices or improvements upon old ones. The officers of railways who are seeking the best means for ultimately reducing the expenses of operation with reference to net earnings are making mistakes unless they recognize the fact that these specialists can generally give them their money's worth. It has been noticeable in the discussions among railway men that many of them are inclined to avoid this recognition and that this is a general tendency among them to, as far as possible, avoid the use of patented devices. This is due to a desire to reduce expenses and a great many devices are prepared by the roads themselves with a view of escaping the slight increase in cost of these articles due to the compensation of the men who produce them. The fact is perhaps lost sight of that the cost of experimental work counts for something no matter who does it, and it may be stated as a fair proposition that the products of those specialists are generally worth what they cost the roads and also that the designs offered are naturally better than may be produced by men who would devise them as a part of their varied and more general field of work. Is there not a danger that by avoiding the employment of patented articles much may be lost in refusing to pay others for work which would cost them perhaps more to do themselves. In many cases it would undoubtedly be better to take advantage of what are as a rule better devices than they themselves can get up for the product of concentrated effort and exploitation is almost sure to be better than the work of men who have many other responsibilities and claims upon their time. There are two sides to the patented article question and both will bear consideration.

CAR FERRIES AGAIN.

SOME comment has been provoked in various quarters because of an article that recently appeared in these columns in reference to the car-ferry problem, if such it can be called. In the article referred to the question was raised as to the legitimacy of the employment of that method of transportation over long distances in competition with rail lines extending between the same points with practically the same mileage. It was conceded that for trans-river service the car ferry was at once efficient and economical; and that even for trans-lake service, when a long land detour was thereby avoided, it was possible to justify its employment. But it was doubted if the more recent development of the idea whereby direct competition with rail lines between the same points is inaugurated is either wise or likely to be of extended duration.

From the comments referred to it is apparent that the A B C of transportation science is as yet in many cases unlearned. Fluctuating rates are an unmitigated evil in the commercial world. It is not supposed, however, that because of such variations commerce is likely to be subjected to an "irreparable shock." So long as people require food, clothing and shelter, so long will commerce continue to move, regardless of the relative fairness of transportation charges. But that does not make it any the less necessary for the proper conduct of commercial enterprises that stability and equality in connection with railway rates should be maintained. That which has had most to do with making the act to regulate commerce inoperative to produce the result for which it was enacted is its failure to require equality of charges for similar service as between different lines, as well as between different individuals by the same line—an error that will probably be rectified in the near future. This proposition lies at the very foundation of public transportation, and any attempt at regulation which ignores it must of necessity fail.

Applying this principle to the particular case in point. to-wit: the transportation of loaded cars without breaking the bulk on floats from Peshtigo to Chicago in connection with the Wisconsin & Michigan Railway, it is not difficult to perceive that the assertion of the right to perform such transportation service at a less rate than is specified in the lawful tariffs in force between the various points affected is wholely illegitimate. If the regular tariffs are reasonable the carriers engaged in transportation between such points are entitled to the amount of such tariffs. Interstate commerce is a comprehensive term and includes much more than simply traffic crossing state lines. The maintenance of interstate commerce is a public necessity, and nothing that threatens either its life or its efficiency can be considered legitimate. The fact that for years such violations have been winked at and often encouraged furnishes no argument in favor of a continuance of the practice. Railroads are denied the right to protect themselves. They are subject to such regulations as is necessary to promote the best interests of the body politic, and being thus subject they are entitled to protection against illegitimate attacks of outside sources.

It is because of the failure to enforce this obligation of protection that such enterprise as the building of the West Shore and other unnecessary transportation lines, have been and are projected. It is not intimated that the particular line under consideration was established for the purpose of blackmail as was the West Shore road, but it is more than suspected that had the obligation to maintain rates on interstate commerce been a prererquisite to engaging therein, the new line would now have been projected. The subject is much broader shan that of a mere strife for rates between contending shippers. It includes the maintenance of the American railroad system upon a basis that shall be equitable to all concerned. The people of this country should not be compelled to pay an unnecessary tax on transportation because of the unwise (or worse) construction of needless facilities; nor should existing transportation lines be subjected to a reduced scale of revenue below that required to maintain themselves with efficiency and profit. It is not expected that such consideration as these will prove sufficient to restrain projectors of such enterprises who see or think they see a chance for profit; but it is believed that the principle enunciated is the correct one, and as such will sooner or later become recognized as the proper rule of action.

INSTRUCTION IN RAILROAD BUSINESS.

It will be remembered that recent reference was made in these columns to the advisability of changing the ordinary course of promotion in railroad service so that the position of station agent should be the ordinary goal of ambition instead of the general office, as is now the case. This of course presupposes that the position of station agent shall be raised very much above its present level, and that those who are regarded as competent for its duties shall be of such character and education as to command the respect of any community in which they might for the time being be located. It was also suggested that inasmuch as a knowledge of details was necessary to the proper performance of such duties, the natural progression should be through the railway station, to the division or the general office, and that in connection with the latter, a course of instruction should be had in which the theories and principles

unnderling railroad traffic should be taught. This suggestion has met with considerable approval among some of the more progressive railroad men as being likely to add to the efficiency of the station service.

A consideration of the details involved in such a scheme has suggested another idea which may be of possible value. In the mechanical branch of railroading, it is admitted that a thorough course of training in the technical schools enables a man not only to advance more rapidly in that line of business, but also better fits him for the duties which he is likely to be called upon to perform. It requires no extended observation to see that it is the technically educated man that soonest gets to the front in this department, and while there are still a few men who profess to have little use for the "book mechanc" and insist that the "practical" man is the superior man, the large majority recognize the advantage of a technical training and testify that when supplemented with a much shorter practical experience than would otherwise be possible, the superior man is the result. Why, then, should not the same rule hold good in connection with the business of railroads? It is true that railroad mechanics more nearly approach to the grade of an exact science than does railroad business, and yet, the latter is fast becoming so systematized as to admit of very similar treatment in all portions of the country.

The consideration of this fact naturally leads to the conclusion that if a school of technology is a valuable instrument for the training of persons desiring to engage in railway mechanics, a similar school, having for its purpose instruction in railway business should be equally valuable. It does not seem to be necessary that a man should spend from two to five years on a "bill desk" in order to know all about the making of way bills, nor that after leaving the bill desk, he should devote a similar period to "freight received," and so on through the various branches of station work and from there through the general office. A school of instruction could be so arranged as to give all of the necessary experience in these various branches of the work. It would of course be necessary that the instructors are or should have been experienced railroad men, who have themselves gone through the various steps it is proposed to teach. They should also be men who are thoroughly acquainted with the theories underlying the various rules of practice in force upon railroads, so that they may give to their pupils an understanding of the reason why such rules are necessary.

It may be objected to such a suggestion, that inasmuch as a school of instruction of this character would correspond in some respects to the so-called commercial colleges of the country, the same estimate of efficiency or, rather, lack of efficiency, would be likely to attach thereto. To this it may be said that unless such an institution was projected under the immediate supervision of the railroads themselves and furnished with instructors who are known to have had the experience requisite to qualify them for the position, the criticism would be justified, but this would not be difficult to accomplish. There are a number of men who might be named who, associated together, would guarantee the success of such a school. The idea is at least worthy of consideration, and it seems to promise a means of supplying to the railroads a class of men from which a superior grade of agents and officers can be drawn.

RADIAL STAYS VS. CROWN BARS FOR LOCOMOTIVE BOILERS.

The question of the relative merits of crown bars and radial stays for locomotive boiler construction was for a long time a prominent one before the Master Mechanics' Association, and, in fact, it appeared so often as to lead one of the members during the last convention to call it a "standard subject for discussion". That comparatively few boilers are now fitted with crown bars—about ten per cent as stated by Mr. Vauclain—at such an establishment as the Baldwin Locomotive Works, is ample evidence that the majority of designers of locomotives consider the radial stay type as preferable. It has been thought that this question was solved for good some time ago, and so it has been among railroad men, but it was brought up at the Saratoga convention of the Master Mechanics' Association by one of the members who quoted the following paragraph from a report of the commissioners of Railroads of the state of New York:

"In the explosion of locomotive boilers which have taken place in this state in several years past, many of them have been of boilers with crown sheets supported by radial stays. While there have been explosions of boilers where the fire-boxes have been constructed with crown bars and rivets, the complete destruction of fire-boxes in the former type were absent in the latter. Much has been said and more may be said as to the relative merits of crown bars and radial stays in such construction. The board believes this is a subject which should receive the earnest consideration of all persons engaged in boiler construction."

The occasion of the paragraph was the explosion of a locomotive boiler on the Delaware, Lackawanna & Western Railroad, February 19, of this year, near Richfield Junction. This and other occasions on which boilers of the radial stay type had exploded caused the commission considerable concern, and the member of that body who was present at the discussion expressed satisfaction at having the opportunity to receive the opinions of the Master Mechanics' Association upon the subject. It must be remembered that this commission practically condemned the radial stay boiler without having the benefit of the practical experience of railway men and it is not surprising that they did not differentiate between different types of radial stayed boilers.

"The trouble experienced was with boilers of the Wootten type, which are notoriously difficult to keep in order, and if they had enjoyed a wider experience in mechanical railway matters they would doubtless have judged very differently between radial and crown bar staying. Again, the boilers which had exploded and were for that reason brought to their attention had all been burnt on account of shortness of water, which is a severe enough test for any construction. The commissioners apparently base their estimate of radial staying upon the fact that the boilers of that type were completely destroyed, whereas those with crown bars did not suffer so badly. In the first place, a boiler with the water line down within eight or ten inches of the mud ring, as the commissioner stated was the case in the explosion under consideration, ought to be expected to have something happen to it, and under such circumstances, as explosions are in order regardless of what form of staying is used. Under such conditions the responsibility for the explosion should not be placed upon the staying any more than upon the headlight.

There is a valuable feature in the discussion of this subject, however, which will amply repay the amount of time devoted to it, namely, the fact that when boilers with radial stays are allowed to run short of water to the extent of exposing the crown sheets they are much more likely to "come down" gradually and gently with no worse result than to put out the fire and necessitate repairs to the fire-box. The arched form of the crown sheet of the radial stay boiler has much to do with this gentle manner of relief of pressure which would otherwise become an explosion. The crown of the arch is heated first, which gives the portion of the sheet supported by a few rivets an opportunity to heat and soften before the rest. The result is to bulge the sheet between the stays, which, when carried far enough, will open small holes around the stay bolts and cause the steam to put out the fire, besides relieving the pressure on the boiler. With ordinary cases of low water this may be expected to occur, and with radial stay boilers explosions are not greatly feared. In consequence of this, the usual method of blowing crown sheets down, radial boilers have been given such confidence, according to another speaker in the discussion referred to, as lead an engine runner to deliberately burn the crown sheet of his engine, presumably to lay it up for repairs.

The fire-box when stayed radially is not rigidly fixed but may bulge and the inside box may become greatly distorted before an explosion occurs as is shown by several cases which are on record This does not apply to the crown bar staying which provides a stiff platform supported upon the sides upon the corners of the side sheets and strengthened also by sling stays. It may be fairly expected that by the time the sling stays are broken the whole structure will go to pieces. Aside from the strength of construction however, a great advantage is possessed by the radial staying because of the ease with which boilers may be cleaned of mud and scale and also the greater convenience in repairing. To use crown bars upon a crown sheet of a boiler which is to carry two hundred pounds pressure involves filling a considerable space with the bars which seriously restricts the steam space and also renders it practically impossible to clean the crown sheet or to inspect the staying properly.

Another point was brought out in that the use of button headed rivets upon six or seven rolls of the center stays, has been found beneficial especially in causing the gradual relief of the pressure of opening out the rivet holes. This practice is not general though the idea is not new in this application and it appears to deserve consideration. The use of these button headed stays arranged upon the radial plan, with such angles given to them as will bring the stresses upon them as nearly as possible in direct lines without bringing the stress upon the stays at an angle, gives the most satisfactory and the safest system now in use. In corroboration of this opinion as to the relative merits of the two kinds of staying is the resolution introduced by Mr. William Forsyth after the discussion referred to, to the effect that the radial stay boiler was considered as safe as the crown bar and that it was very much more easily kept clean. The commissioners were given an opportunity to get some valuable information about staying and the association also may profit by the light of present day experience when thrown upon this change which has been made in their practice. One thing however, that the commissioners should not fail to fasten in their minds is that radial stay boilers are not all alike. The railway men should learn the absolute necessity of frequent inspection of boilers and if this is carried out there will not be many explosions of any type of boiler.

RAILWAY MASTER MECHANICS' CONVENTION REPORTS OF COMMITTEES.

STEPS AND HANDHOLDS.

In presenting its report on the subject of locomotive "Steps and Handholds," your committee is pleased to state that its circular of inquiry elicited a response from 45 members, nearly all of whom evinced a full appreciation of the importance of the subject. Our queries were as follows:

1. What form of steps and handholds do you prefer leading to gangway of cab?
2. Do you consider the common arrangement of a step, each on back of engine and front of tender, sometimes confusing and dangerous?
3. Do you favor the arrangement of wide steps depending from the front of tender frame, dispensing with the engine step?
4. What arrangement of steps and holds do you prefer leading (1) to the headlight, (2) to sandbox?
5. What form, if any, of steps and handholds do you use or recommend for the back end of tender?

Replies to Question No. 1 show that 29 use or favor the use of a wide double step secured to the tender frame at each front corner and none at back corners of the engine. Eight prefer a wide step, each at back corner of engine and front of tender, while others see no objection to the once common practice of a fixed step on the front corner of the tender and a foot-pad, adjustable to a round hanger, suspended from the rear of engine. Nearly all recommend long vertical grab-irons, or handholds, conveniently arranged at the front corner of tank, back of cab, and in connection with the cab bracket.

To Question No. 2, thirty-three reply "yes," and six "no." Six are qualified or uncertain.

Question No. 3. Thirty-two favor wide steps on the tender only, while nine prefer wide steps on both back corner of the engine and front corner of tender. We recommend that the distance between the tread and opening be not less than 5 in.

Question No. 4. While a diversity of opinion exists with reference to the form and location of steps and handholds with which to reach the headlight, substantially all agree that on locomotives with extension smoke boxes a firm step with roughened tread and flanged sides should be fastened to the smoke-box sheet at a convenient position between the steam chest and headlight. Supplementing the ordinary handrail, a short rail fastened horizontally to the smokebox is often used, and in addition some require a curved rail either over or under the front door. Also a step fastened to a pilot is sometimes necessary. Such details, however, must be governed by local conditions, which vary to such an extent as to preclude the adoption of a fixed plan; the general arrangement as shown by the locomotive elevation represents substantially the practice of a majority of our railways, and is one which we can safely recommend.

For reaching the sandbox a step similar to that on smokebox seems to meet the requirements.

Question No. 5. Twenty-two members see no necessity for steps at the back corners of the tender. Twelve approve the plan of steps and handholds uniform with those at front corners of tender. Steps suspended transversely from the back of tender frame are necessarily restricted to switching and pushing locomotives. For this purpose we can recommend a simple form of long step with back guard to prevent foot from slipping through. It should be made and applied in a substantial manner and set at the uniform hight of 12 in. from the rail. Care should be taken to leave an opening between the tread and riser sufficient to dispose of ice and snow, but not large enough to admit a part of the foot. In connection with this step, a long, horizontal handrail should be placed at a convenient hight. On road engines various kinds of steps or ladders are used with which to reach the top of tank at back.

In conclusion, your committee is of the opinion that to insure comparative safety the form and location of locomotive steps and handholds should be so nearly uniform that in mounting or alighting one could, even in the dark, readily locate with his feet and hands all the steps and handholds of any locomotive. To this end we would recommend for adoption the plans herewith submitted.

RECIPROCATING PARTS.

The great increase in the sizes and weights, and also in the boiler pressures of locomotives which has been made during the past ten years, to meet the demand for greater hauling capacity and higher speeds, has made it necessary to largely increase the size and strength of most of the parts. The increase in mass and strength has, perhaps, made the locomotives more capable of absorbing without injury to themselves, the greater portion of the disturbances caused by the reciprocating parts, but the numerous reports of damaged tracks, bent rails and broken bridges that have been caused by badly balanced engines, the now common practice of high maximum speeds and the introduction of the compound locomotive, with its large reciprocating weights, have all served to attract attention to this subject.

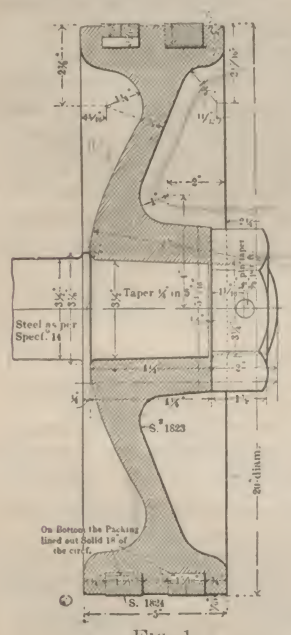

FIG. 1.

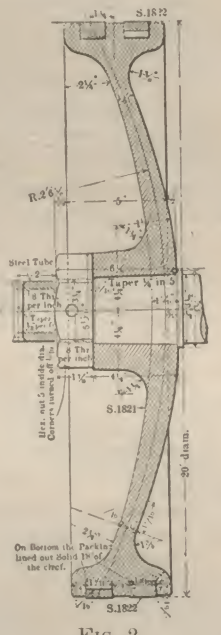

FIG. 2.

The result has been that probably during the past few years more thought and study has been given to this subject of counterbalancing than in all the previous history of the locomotive. That the matter has received careful attention is evidenced by the able reports that have been made to this association, and the valuable papers that have been read before the railway clubs and other societies, as well as the numerous articles that have appeared in the technical papers, so that the whole question is to-day better and more generally understood than ever before, and there is no point that has been more clearly brought out than that of the great desirability of reducing the weight of the reciprocating parts to the lowest possible limit consistent with necessary strength.

The use of cast iron for pistons has been almost universal in this country, principally because they can be easily and cheaply made of this material, and also because of the low cost of maintenance and renewal. Cast iron is not only relatively a weak metal, but the stresses due to uneven contraction in cooling necessarily compel designers to make cast iron pistons stronger than would theoretically be needed to resist only the external forces; also, in spite of the many advantages cast iron has over other iron and steel for piston material, the allowable stress cannot be great. A comparison of the relative strength and cost of mild or soft steel and cast iron would seem to indicate that the substitution of steel, either cast or in plate form, forged or pressed, or perhaps a combination of both, would offer the most practical solution of the problem of how to effect a saving in weight here without unduly increasing cost, and your committee finds that much progress has been made in the use of this metal for pistons, and in most cases a large reduction in weight has been the result.

In design the single plate form seems thus far to have been the most in favor, and undoubtedly this type permits of the greatest possible reduction in weight consistent with a proper degree of strength. For very large pistons for the low-pressure cylinder of compound engines it is certainly to be preferred to any type that has yet been brought out.

Although the single plate solid cast or forged steel piston probably presents the best form for combining strength and lightness, the wear between piston and cylinder, due to the greater co-efficient of friction, presents an objection to its use which it has been sought to overcome in various ways; and further, when the cylinder has been worn to such an extent that reboring is necessary, and the piston is consequently too small, your committee could not learn that any satisfactory method had yet been devised for enlarging it, consequently the whole piston must be thrown away.

Figs. 1 and 2 illustrate a very handsome, strong and light design for cast steel single plate pistons, and which is used in the class "K" two cylinder compound built by the Chicago, Burlington & Quincy Railroad. Eccentric spring packing rings of cast iron are lined solid on the bot-

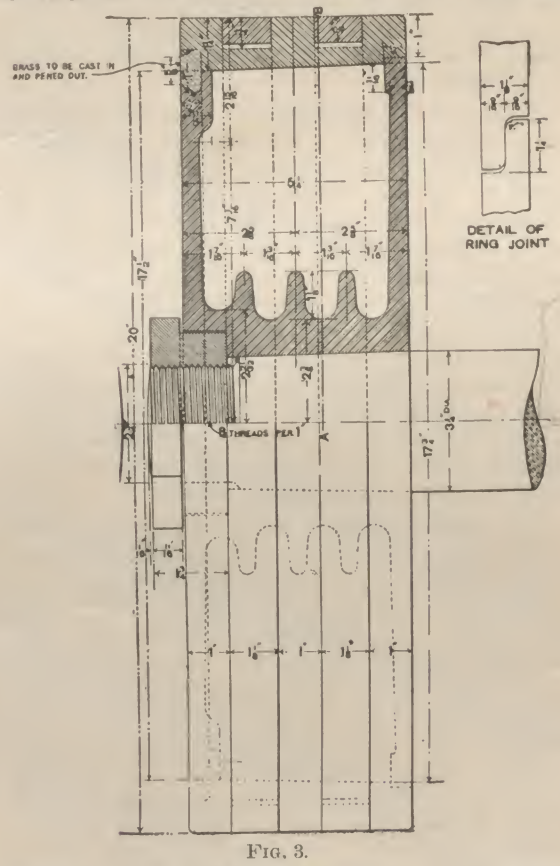

FIG. 3.

tom, 12 in. of the circle in high pressure cylinder, and 18 in. in the low pressure cylinder. The low pressure piston rod is extended through and supported by the front cylinder head. To reduce as much as possible the weight of this extension it is made of steel pipe, which is internally threaded and screwed on to a short extension of the rod. These pistons were designed for 180 lbs. steam pressure, and weigh as follows:

Weight 20 in. cast steel piston (Fig. 1)	221 lbs.
Weight piston rod	94 lbs.
Weight 3 in. nut	5 lbs.
Total	320 lbs.
Weight 29 in. cast steel piston (Fig. 2)	395 lbs.
Weight solid rod	94 lbs.
Weight hollow extension rod	46 lbs.
Weight 3 in. nut	5 lbs.
Total	540 lbs.

The Pennsylvania Railroad has designed and is using a piston which is a combination of a single plate, dished in shape, cast or forged steel, and a cast iron rim secured to the plate by countersunk head screws. The rim is made much the widest at the bottom, where it bears on the cylinder. This design combines the lightness and strength of the Z plate, with the additional advantages of a good wearing surface and ease of renewal.

One objection to this design is that if great care is not exercised in fitting up the pistons there may be leakage around the bolts. The rings must be nicely fitted and drilled to jigs, holes tapped and bolts well threaded and made steam tight. After bolts are screwed up they should be tightly riveted up, care being taken that they are not loosened in the operation. These pistons have been in service about two years with good results.

The designs in single plate pistons, which have mentioned and illustrated, have been made principally for high speed and high pressures, and are given as good examples of what can be done where it is very desirable to reduce the weight to the lowest possible limit consistent with strength, the question of cost being secondary. With this type of piston, in order that the clearance spaces may not be too great, it is necessary that the shape of the cylinder heads should be made to conform to that of the piston, and it is recommended that the surfaces of pistons and cylinder heads should be turned all over, although this is not absolutely necessary, providing the work of casting and fitting up the parts is well done.

Fig. 3 shows a 20 in. solid or box piston, blue print of which was furnished by the Norfolk & Western Railroad. This is made of malleable iron, and is very interesting as showing the possibilities of the application of malleable iron in the construction of light pistons. The report of Mr. G. R. Henderson, mechanical engineer of this road, to Mr. R. H. Soule, superintendent of motive power,

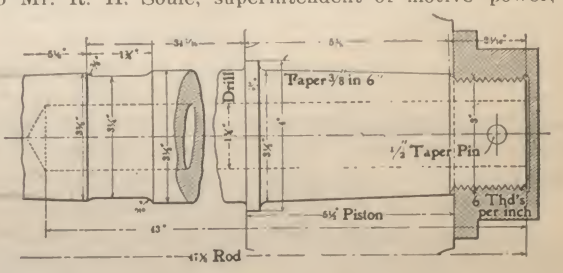

FIG. 4.

copy of which was sent with blue print, gives results of a test made of this piston in comparison with a solid cast iron piston. Report states that pressure was first applied to center of malleable portion to try strength of brass retaining ring, and at 78 tons on wheel press the outer cast iron wearing ring broke, the malleable iron center being only slightly damaged at edges. The piston was then put on wheel drop, supported on a cast iron ring around the outer edge, given 50 blows with 140 lb. drop falling 12 ft. This merely curled up the edges somewhat, and it was then taken to a casting breaker and given one drop of 5 ft., one of 8 ft., one of 12 ft., and two of 18 ft. when it broke badly. The solid cast iron piston cracked at 10 blows of a 140 pound drop, and went all to pieces on the 14th blow, showing that the malleable was much the stronger. In service the pressure tending to force off the outer ring would only be the steam pressure multiplied by the area, about 15,000 lbs., which gives a factor of safety for that portion of about 10. The cast iron piston weighed 257½ lbs., while the composite weighed but 187½ lbs., a gain of 70 lbs. Mr. Henderson thinks this type, having shown such remarkable results, can be still further reduced in thickness, thus further reducing the weight, and he expects to make other experiments with this end in view.

Piston rods have always had a circular section, and no other section can be had as good for the same purpose. Iron has been very largely replaced by steel. The only way that the weight of this part can be reduced is to make the rod hollow, plugging the ends to prevent steam from coming through. A design for hollow rod is shown in Fig. 4 and is submitted by the Schenectady Locomotive Works, who state that they have not yet used this design. Their latest practice is to make the ends or fits larger than the body of the rod, which enables them to make the rod lighter than if the cross-head fit was made in the usual way, and also diminishes the risk of breakage. This practice, in connection with the hollow rod, would give the lightest possible form. We find that it is now the almost universal practice to secure the piston to the rod by a single nut, instead of keys or pins, as was formerly done. This is no doubt largely due to the increase in steam pressures which has been made

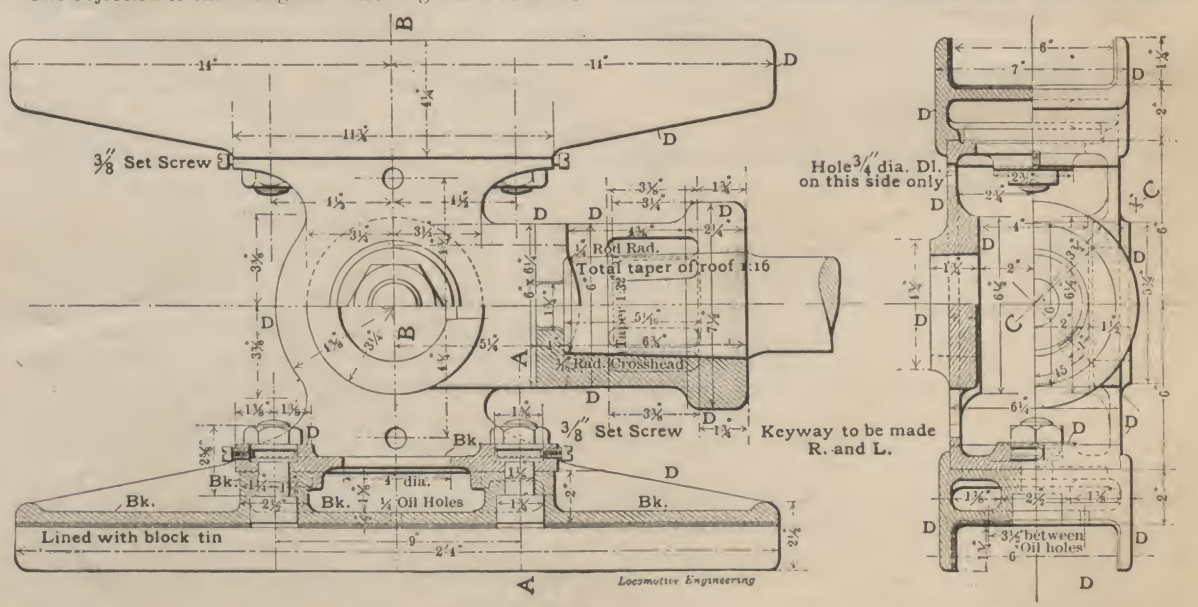

FIG. 5.

during the past few years, and which has rendered desirable a safer and more reliable form of construction.

The substitution of steel for cast or wrought iron would seem to offer the most promising method of reducing the weight of cross-heads, and your committee finds that in several recent designs for high speed locomotives, as well as being freight locomotives, this metal has been employed with good results.

The cross-head shown in Fig. 5 is used by the Pennsylvania Railroad in its new type of mogul heavy locomotive for fast freight. The compound locomotive of this type carry 205 lbs. pressure, and the simple 180 lbs. The cylinders of the former are 20 in. and 30 in. diameter, and of the latter 19 in. in diameter. The cross-head is all cast steel and weighs 296 lbs. The bearing surfaces are all lined with block tin. The shoes are drilled with jigs, and other shoes can be quickly substituted when necessary to re-tin them.

This crosshead is a very good example of what can be done by the substitution of steel for iron, the comparison of the design with the Class "R," having same type crosshead, but made of wrought and cast iron, and which is given herewith in table, gives a reduction in weight of 108 pounds, with a difference of 14,141 lbs. total piston pressure in favor of the Class "R."

In main rods, as now used on locomotives for very high speeds, and which are subject to the stresses due to the up-and-down motion at 400 or more revolutions per minute, it has been found necessary to place the metal where it would be most effective. This is undoubtedly the I section, with broad top and bottom, and substituting steel for iron, the allowable stresses are somewhat greater, and the web and flanges can be made thin, which has the effect of considerably reducing the weight. Your committee believes that main rods of steel and of properly designed I section, and of solid front ends, will provide about as much reduction in reciprocating weight as can be had from this source.

Mr. F. D. Casanave, general superintendent of motive power of the Pennsylvania Railroad, sends the following table, which gives a comparison of the weight of reciprocating parts for the Class "P" 18½-inch cylinders, 160 lbs. pressure, and the Class "L" 18½-inch cylinders, 185 lbs.

TABLE No. 1.

PENNSYLVANIA R. R.—COMPARISON OF WEIGHTS OF RECIPROCATING PARTS.

CLASS OF ENGINE	"P."	"L."	"R."	Mogul.
Main rod, front end	144½ lbs.	121 lbs	171 lbs.	104½ lbs.
Crosshead, complete	174 "	146 "	277 "	269 "
Piston and rod, complete	310 "	269½ "	368 "	324 "
Total reciprocating wt.	628½ "	536½ "	816 "	697½ "
Total piston pressure	43 008 "	49.729 "	43.982 "	58,123 "
Piston pressure per lb. of reciprocating wt.	68.4 "	92.7 "	53.9 "	83.3 "

pressure. Also a comparison between their Class "R" consolidation freight engine, 20-inch cylinder, 140 lbs. pressure, and the mogul freight engine, 19-inch cylinder, 205 pounds pressure. It will be seen that, notwithstanding there is a very decided increase in piston pressure of the Class "L" over the Class "P," and in the mogul over the Class "I," in both cases there is a large reduction in the reciprocating weight.

Mr. F. W. Webb, locomotive superintendent of the London & Northwestern Railway, and Mr. W. Worsdell, locomotive superintendent of the Northeastern Railway of England, have furnished your committee with information regarding the reciprocating weights of some of their standard locomotives, and which is given in these tables:

TABLE No. 2

LONDON & NORTHWESTERN RY.—WEIGHTS OF RECIPROCATING PARTS.

CLASS OF ENGINE	SIZE OF CYLINDERS. Diameter	Stroke.	Diameter of Wheel with ½-inch Tire.	WEIGHTS OF DIFFERENT PARTS. Piston and Rod.	Crosshead.	Connecting Rod. Reciprocating.	Revolving	Total.	Total Reciprocating Weight.
	In.	In.	In	lbs.	lbs	lbs.	lbs.	lbs.	lbs.
7 ft. comp'd eng. (8 wheeled)	H. P., 15	24		161	158	117	225	342	436
"Greater Britain" class	L. P., 30	24	85	441	179	113	343	456	733
7 ft. comp'd eng. (6 wheeled)	H. P., 14	24		160	138	117	225	342	415
"Teutonic" class	L. P., 30	24	85	488	179	113	343	456	780
6-ft. comp'd eng. (6 wheeled)	H. P., 14	24		156	138	117	225	342	411
"Dreadnought" class	L. P., 30	24	75	441	179	113	343	456	733
6 ft 6 in. four wheels, coupled, passenger eng.		17	24	81	101	71	122	242	364	384
4 ft. 6 in. four wheels coupled, side tank passenger eng.		17	24	56½	185	71	122	242	364	378
Six wheels coupled. Goods eng.		18	24	62½	234	130	97	325	422	461
4 ft. 3 in. eight wheels coupled Compound Goods eng.	H. P., 15	24	53½	156	224	77	191	268	457
4 ft. 3 in. six wheels coupled, Goods eng.	L. P., 30	24	53½	441	179	156	376	522	776
		17	24	53½	191	71	122	242	364	384

NOTE.—All weights are for one cylinder only.

TABLE No. 3

NORTHEASTERN RY. OF ENGLAND—WEIGHTS OF RECIPROCATING PARTS.

CLASS.	Class Letter	DRIVING WHEELS. Diam.	Number Coupled	CYLINDERS Diam.	Stroke.	Valve Gear	Pistons and Rods.	Crosshead Gudgeon and Slide Block.	Main Rod.	Total, One Cylinder	Remarks.
		In.		In.	In.		lbs.	lbs.	lbs.	lbs.	
Passngr.	A.	66	4	18	24	Joy's	234	225	401	840	Loose crosshead cottered to rod. Two loose slide blocks.
"	F. F. 1	78	4	18	24	"	244	205	442	891	
"	J.	90	None	20	24	"	364	131	453	948	Crosshead forged in one piece with piston rod, and weighed therewith. Two loose slide blocks.
"	M. 1	84	4	19	26	Eccentric	339	131	446	926	
"	M.	84	4	20	26	"	364	131	446	941	
Goods	C. C 1	60	6	18	24	Joy's	234	222	437	893	Cast steel crosshead working on single guide bar.
"	P	54	6	18	24	Eccentric	234	222	383	839	
Passngr.	F.	78	4	26	24	Joy's	392	205	442	1039	Low pressure side of compound engine—the piston rod is extended through front cover
"	J.	90	None	28	24	"	502	131	453	1146	
"	M.	84	4	28	26	Eccentric	567	131	446	1144	
Goods	C.	60	6	26	24	Joy's	382	222	437	1041	

Mr. J. A. F. Aspinall, chief mechanical engineer of the Lancashire & Yorkshire, also sends the following details regarding weights of parts of three classes of engines on that road that are interchangeable:

TABLE No. 4.

LANCASHIRE & YORKSHIRE RY.—PARTICULARS OF STANDARD ENGINES RECIPROCATING PARTS.

	Bogie Pass. Eng.	Goods Eng.	Radial Tank Eng.
Driving wheels	87 in. dia.	61 in. dia.	68 in. dia.
Cylinders	18 in. dia.	18 in. dia.	17½ in. dia.
Cylinder stroke	24 in.	24 in.	24 in.

WEIGHT OF RECIPROCATING PARTS WHICH ARE INTERCHANGEABLE WITH EACH OTHER.

1. Piston head	144 lbs.	
2 Piston rings	10½ "	
1. Piston rod	93 "	
1. Piston rod nut	7 "	
1. Piston rod cotter	¼ "	piston and rod, 254¾ lbs.
1. Crosshead	67 "	
1. Crosshead cotter	3½ "	
1. Gudgeon pin	17 "	
2. Slide blocks	62 "	crosshead, 149 lbs.
1. Connecting rod complete	436 "	
Total	840 lbs.	

Mr. J. F. McIntosh, locomotive superintendent of the Caledonian Railway of Scotland, sends list of weights of the reciprocating parts of the last new engine built for that line, cylinders 18¼ in. diameter, 3 in. stroke, driving wheels 78 in. diameter:

Weight piston and rings	144 lbs.
Weight piston rod and crosshead	126 lbs.
Weight piston rod, nut and pin	9 lbs.
Weight crosshead pin	21 lbs.
Weight slide blocks	47 lbs.
Weight connecting rod	471 lbs.
Total	818 lbs.

It would seem, from the manner in which the weights are given, that the body of the crosshead and the piston rod are forged in one piece, and slide blocks are afterwards put on. The weights are not as low as some that have been given for locomotives of corresponding size.

Mr. McIntosh states that these reciprocating parts have been adjusted from the original Caledonian engines, as they were in his opinion too light.

COUNTERBALANCING.

Your committee on "Counterbalancing Locomotives," knowing the great amount of time which this subject has been given in the different railroad clubs of this country and the thoroughness with which it has been investigated by their members, have first tried to ascertain what rules and methods are now generally employed on the principal American railroads. Fifty inquiries were sent out, to which nineteen responses were received, divided as follows: All those replying balanced the full weight of the revolving parts in each wheel, to which was added various proportions of the reciprocating parts as follows: Ten, two-thirds of the reciprocating parts divided equally between all drivers, Four, three-fourths; two, less than two-thirds, and three. various other methods.

The purpose of adding counterbalance weights to the driving wheels of locomotives is to prevent or minimize the strains and vibrations caused by the momentum or inertia of the moving parts attached directly or indirectly to them. These are of two kinds, revolving parts and reciprocating parts. The revolving parts can be counterbalanced by weights attached to the wheel to which they belong. The reciprocating weights can only be balanced in one direction by adding weights to the driving wheels, as all weights added after the revolving parts are balanced overbalance the wheel wheel vertically, exactly to the same extent that they tend to balance the reciprocating parts horizontally. This overbalance exerts a pressure upon the rail directly proportional to its weight and to the square of its velocity. At high speeds this pressure which is added to the weight of the driver on the rail may become great enough to injure track and bridges.

In consideration of the above your committee has formed the rules which follow after full consideration of the following fundamental principles:

First: The weight of the reciprocating parts that are left unbalanced should be as great as possible, consistent with a good riding and smooth working engine.

Second: The unbalanced weight of the reciprocating parts of all engines for similar service should be proportional to the total weight of the engine in working order.

Third: Total pressure of the wheel upon the rail at maximum speed when counter-balance is down must not exceed an amount depending upon the construction of bridges, weight of rail, etc., and when counter-balance is up the centrifugal force must never be sufficient to lift the wheel from the rail.

A majority of railroads answering the committee's circular leave unbalanced one-third of the reciprocating parts. In order to see how nearly this method makes the unbalanced weight of the reciprocating parts proportional to the total weight of the engine, we have plotted in the accompanying diagram the relation of the unbalanced reciprocating weight on one side and the total weight of 75 road engines in actual satisfactory service on seven different roads. On the same diagram are drawn lines, all the points in which are proportional to the total engine weights laid off on the horizontal. The first line marked 1—450 is drawn through about the average of all the points plotted, and indicates that the average unbalanced weight of the reciprocating parts on one side of engine as balanced on these roads is 1—450 of their total weight. The upper line marked 1—360 reprerents the ratio of unbalanced reci procating parts on one side to the total engine weight, recommended by Mr. G. R. Henderson, mechanical engineer of the Norfolk & Western Railroad, in an admirable report on this subject made to Mr. R. H. Soule about a year ago and to which your committee is indebted for valuable data and suggestions. Mr. Henderson proposes the following formula for expressing the relation between the unbalanced reciprocating parts and the total weight of the engine:

$$Wr = \frac{Wt}{360}$$

Wr=the weight of the unbalanced reciprocating parts on one side.

Wt=the total weight of the locomotive in working order.

From the data obtainable, we believe this formula allows a greater proportion of the reciprocating parts to remain unbalanced than present good practice will warrant.

The intermediate line marked 1—400 on diagram, indicates the average maximum of unbalanced weight of reciprocating parts in locomotives now in service on various roads. From actual tests of locomotives so balanced in fast passenger service, we recommend it as a safe formula for the maximum limit of the weight of the unbalanced proportion of the reciprocating parts on one side.

In formulating the following rules it is assumed that the driving wheels are finished and mounted on their axles with pins in place.

In designing new locomotives the proper counterbalance weight should be calculated and cast into the wheel centers as follows:

Place the center of gravity of counter weight opposite the crank pin as far from the wheel center as possible, and and have it come as near the plane in which the rods move as proper clearance will allow. To obtain weight of the reciprocating parts and detachable revolving parts, proceed as follows:

Reciprocating Parts.

Take the sum of the weights of piston complete, with packing ring, piston rod, cross head complete, and the weight of the front end of the main rod complete. Weigh each end of rod separately supported.

Revolving Parts.

Weigh the back end of the main or connecting rod, and each end of each side rod complete, separately supported. The sum of the weights so found which are attached to each crank pin are the revolving weights for that pin.

After consideration of the above we recommend the following:

Rules for Counterbalancing Locomotive Driving Wheels.

First. Divide the total weight of the engine by 400; subtract the quotient from the weight of the reciprocating parts on one side as found above, including the front end of the main rod.

Second. Distribute the remainder equally among all driving wheels, adding to it the weight of the revolving parts for each wheel. The sum will be the counterbalance required if placed at a distance from the wheel center equal to the length of the crank. We also recommend the following:

Shop Method of Counterbalancing Mounted Locomotive Driving Wheels.

Place the axle with journals upon the straight edges shown on Plate No. 2, Fig. 1. (This apparatus consists of

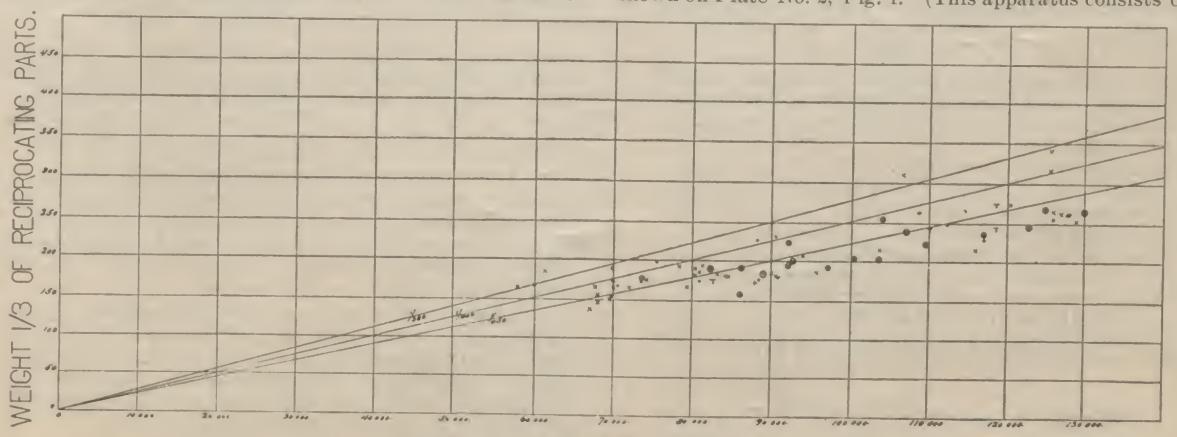

DIAGRAM OF LOCOMOTIVE COUNTERBALANCING.

two wooden horses of substantial construction composed of horizontal cross timber of 4x6 in. oak carried upon legs of 3x5 in. oak. These horses carry wrought iron girders with a section at the center of 7x1 in., having the ends turned up slightly so as to provide stops to prevent the axles from rolling off at the ends. These girders are planed to a straight edge and are supported upon the horses by means of screws 1¼ in. in diameter whereby they may be leveled. There is a wrought iron stirrup of suitable form for hanging cast iron weights upon the crank pins and these weights have lips cast upon them which fit over the sides of the stirrups, to hold them in place), and level the straight edges by means of the adjustment screws. Turn the wheels until the center of one crank pin is above and exactly in a vertical line drawn through the center of the axle.

Hang the yoke on the opposite pin; then add weights until the sum of the weight of the yoke and weights equals the exact weight of all the detached revolving parts on this wheel, plus the proportion of the reciprocating weights determined by rules given above. Increase or decrease the counterbalance opposite the crank pin until it exactly balances the weight thus applied. Repeat this process for the opposite wheel in the same manner.

Counterbalance weights added to old wheels should be generally cast in two parts, fitted between spokes, securely bolted with the ends of bolts riveted over the nuts. Increased weight of counter-balance can be obtained when necessary by boring out cast iron and substituting lead, or in other ways replacing cast iron with a denser material.

Cautions and Limitations.

If we assume that the maximum speed in miles per hour of the driving wheel of a locomotive equals its diameter in inches, it can easily be shown (see appendix) that if such wheel is overbalanced by an amount W, at its maximum speed, this overbalance will increase and decrease the wheel pressure on the rail each revolution 38.4 times W, or denote such increase pressure by P, then P=38.4 times W, or nearly P=40 W. Therefore, in order that the wheel shall never leave the rail, 40 times the portion of the weight of the reciprocating parts added to each wheel must not exceed its static pressure on the rail. To insure safety it should not exceed 75 per cent of such pressure. Nor should this amount, when added to the static wheel pressure, exceed the safe maximum pressure allowed on track and bridges. Locomotives with rods disconnected and removed should not be hauled at high rates of speed.

Make reciprocating parts as light as possible.

Spread cylinders as little as possible.

The following form is shown as a convenient one for reporting the counterbalance as found, and corrections made in engines passing through the shops.

A., B. & C. RAILWAY CO.

Report of counterbalance in engine No. . . . . at . . . . . shops, ... 189 . .

Reciprocating Parts.

Weight of piston, packing rings and crosshead, complete, . . . lbs.
Weight of front end of main rod complete, ——— "
Total weight of reciprocating parts, . . . "
1-400 weight of engine, only in working order, ——— "
Difference distributed equally between driving wheels on one side, . . . "
Counterbalance on each wheel for reciprocating parts. . . . "

Weights to be Counterbalanced, and Report.

Weights to be balanced.	1st. Wheel.	2nd. Wheel.	3rd. Wheel.	4th. Wheel.	5th. Wheel.
Proportion of reciprocating parts					
Weight of rod ends attached to pins					
Total weight to be balanced at pin					
Present counterbalance weighed at pin					
Present counterbalance light					
Present counterbalance heavy					

Counterbalance corrected as above.

The committee recommends that a number of roads be selected to try the rules outlined, and report result of the trial before the convention of 1897; and that the committee be continued until that time, when, if the practice is found satisfactory, it can be adopted as standard.

Appendix.

We take the following from Mr. Henderson's report:

"To determine the centrifugal force, we have from Weisbach, Vol. 1, page 609, the following formula.

P=.00034 U^2 G R

U=Revolutions per minute.

G = weight in pounds.

R = radius in feet. Now let

s = speed in miles per hour;

d = diameter of wheel in inches, then

$$U = \frac{s \times 5280 \times 12}{3.1416 \times d \times 60} = \frac{s \times 1056}{d \times 3.1416} = 336\frac{s}{d}$$

and $U^2 = 112896\frac{s^2}{d^2}$ and, substituting, we have,

$$P = 38.4\frac{s^2}{d^2} G R \quad \text{and where } R = 1,$$

$$P = 38.4\frac{s^2}{d^2} G$$

If we assume that the speed in miles per hour at its maximum equals the diameter of the wheel in inches, we have simply

P = 38.4 G, or say, P = 40 G.

PERSONAL.

Mr. K. H. Bates has been elected president of the Kansas City, Oklahoma & Southwestern.

Mr. J. T. Atwood has been appointed chief engineer of the Pittsburgh & Lake Erie Railroad.

Mr. E. K. Darlow, assistant superintendent of the Vandalia & St. Louis, has been made assistant secretary.

Mr. W. B. Turner has been appointed traveling freight agent for the Vandalia line, with headquarters at Fort Worth, Tex.

Mr. Harry S. Stirling has been appointed general freight auditor of the Union Pacific road, succeeding Mr. A. S. Van Kuran, deceased.

Mr. Albert S. Miller has been assigned as traveling passenger agent of the Chesapeake & Ohio, with headquarters at Indianapolis.

Mr. H. S. Ball, formerly with the Merchants' Despatch and Erie Despatch, has been appointed contracting agent of the Continental Fast Freight Line.

Mr. C. A. Barnard, who was recently made assistant general freight agent of the Lima Northern road, has been again promoted, and now holds the position of general freight agent.

Mr. A. R. Dillon, who has been secretary to the general manager of the Frisco, left the service on the 1st to become secretary and treasurer of the Suburban Street Railway of St. Louis.

Mr. A. C. Ridgeway, assistant superintendent of the second and third divisions of the Denver & Rio Grande, has been appointed general superintendent of the Florence & Cripple Creek road.

Mr. Leon Lurton, who has recently been at Nashville, Tenn., as representative of the Southern Railway, has taken service with the Illinois Central at Louisville as traveling freight agent.

Mr. Wm. H. Chandler, one of the best known railway men in the west and since 1864 general agent of the Star Union Line, died in Chicago, June 27, after a protracted illness, at the age of 76.

Mr. C. F. Elliott, chief clerk to the president and general manager of the Florence & Cripple Creek, has been appointed general traffic agent of that road, with headquarters at Florence, Col.

Mr. W. F. Baldwin, formerly connected with the passenger department of the Monon and afterward with the Pullman Co., has been appointed joint agent of the roads of the Joint Traffic Association at Buffalo.

Mr. Joseph H. Craig, since 1892 auditor and purchasing agent of the Louisville, New Albany & Chicago, has resigned, and Mr. Joseph L. Doherty will for the present have charge of the auditing department of the road.

Mr. Edward Fitzgerald, formerly with the Louisville & Nashville as traveling freight agent, has been appointed general western agent of the Southern Railway. On the Louisville & Nashville he is succeeded by Mr. R. P. Williams.

Mr. G. M. Dugan, superintendent of telegraph of the Illinois Central, has been elected president of the Association of Railway Telegraph Superintendents. The next annual convention of that organization will be held at Niagara Falls.

Mr. J. M. Cutler, has recently been made southern representative of the Chicago & Eastern Illinois Railroad. He will have his headquarters at Atlanta, and will have charge of the business of North and South Carolina, Georgia and Florida.

Mr. Charles A. Ulrich has been appointed soliciting agent at Detroit for the Baltimore & Ohio. For the past two years he has been soliciting agent for the Clover Leaf. Previous to that time Mr. Ulrich was connected with the Michigan Central.

Mr. S. H. Dare, who was formerly connected with the Nashville, Chattanooga & St. Louis Railway, has been appointed contracting freight agent of the Plant System and the Canada & Atlantic Steamship Co., with headquarters in the Marquette Building in Chicago.

According to official report Mr. Leonard Goodwin, assistant trainmaster of the Lehigh division of the Lehigh Valley and Easton & Amboy Railroad having been transferred to the Elmira & Cortland branch of Auburn division, the office of assistant trainmaster is abolished.

Mr. Sol Haas, a well known railroad man in the south, has been elected president of the Sloss Iron Company, in place of the late Mr. Thomas Siddon. Mr. Haas was formerly traffic manager of the Richmond & Danville and more recently assistant to President Spencer, of the Southern Railroad.

Mr. Perry Griffin, who has filled the position of city passenger and ticket agent of the Cincinnati, Hamilton & Dayton, at Cincinnati has been appointed general southern agent of the passenger department of that company, the appointment to date from the 1st of July. Mr. Griffin will still make Cincinnati his headquarters.

Mr. S. H. Hedges, who has been connected officially with the Cincinnati, Hamilton & Dayton for thirty-four years, twenty-eight years as paymaster, this week severed his connection with the company and goes to California for his health. On Monday night last his friends at Cincinnati gave him a banquet and made him appropriate presents.

Mr. George F. Bidwell superintendent of the Ashland division of the Chicago & Northwestern, has been made general manager of the Fremont, Elkhorn & Missouri Valley, to succeed Mr. Horace G. Burt, who is to take the place of General Manager Edwin W. Winter, of the Chicago, St. Paul & Omaha line, recently elected president of the reorganized Northern Pacific.

Mr. John Hutchings has been appointed commercial agent at Detroit for the Baltimore & Ohio. The appointment is to fill the vacancy caused by the resignation of R. J. Menzies, who again assumes the duties of his old position with the Merchants' Dispatch. Mr. Hutchings has been connected with the Wabash at Detroit as soliciting agent for 10 years, which will make him a strong man for the B. & O.

According to official announcement Mr. C. L. Thomas is now general freight agent of the Erie lines west of Salamanca and Buffalo, and Mr. George B. Whittlesey is assistant general manager. The headquarters of both gentlemen will be in the Garfield Building, Cleveland, O., to which place the general freight office of the company was recently moved. All communications should be addressed accordingly.

On July 1, Mr. James Donohue, for three years general freight and passenger agent of the Kansas City, Pittsburgh & Gulf Railway, tendered his resignation to-day. It was at once accepted and Mr. H. C. Orr, assistant general passenger agent of the Burlington route, was appointed in his place. Mr. Orr has been connected with the Burlington for twenty years, sixteen of which he has spent in Kansas City. His new title will be general passenger and ticket agent.

It is reported that General Advertising Agent Ingraham, of the Southern Pacific has resigned from his position, and that Mr. Kneedler, the former attache of the advertising department, was to be his successor. While Mr. Kneedler has not been connected with the Southern Pacific a great while, he has during that time not only shown his worth as an expert in the advertising line, and entirely capable of holding Mr. Ingraham's position, but he has made friends for the company.

Mr. W. Van Vleck, general manager of the Atlantic System of the Southern Pacific Railway, was seriously injured at Houston, Tex., on June 29 by the explosion of a boiler in the office of the Evening Age. The body of the boiler was blown nearly a block, tearing out the front of General Manager Van Vleck's office. He was struck with a brick and for a time it was feared he was fatally injured, but he will recover though badly hurt. The explosion was caused by letting cold water into an empty boiler.

Mr. B. F. Yoakum, since 1893 general manager of the Gulf Colorado & Santa Fe, has been appointed vice president and general manager of the St. Louis & San Francisco Railroad. Previous to his connections with the G. C. & S. F. Mr. Yoakum held consecutively on the San Antonio & Aransas Pass the positions of assistant general manager, general manager, receiver and traffic manager. Mr. Yoakum's appointment lets out Mr. H. L. Morrill, who has been vice president and general manager since 1887.

Mr. H. L. Morrill, who now retires from the positions of vice president and general manager of the St. Louis & San Francisco road, was manager of construction in the building of the Nickel Plate line, and was also at one time general manager of the Hoosac Tunnel road. He entered the service of the St. Louis & San Francisco Co. June 1, 1886, as general manager, and in 1887 had the vice presidency added to his title, and has been with the company ever since. He stands high in railway circles and has a reputation for ability in the handling of operating departments.

The position of assistant general freight agent of the Toledo & Ohio Central has been created, and Mr. E. L. Jameson appointed to it. Mr. Jameson was the first messenger boy in the employ of that company after its reorganization in 1881. He has for some time past been general agent of the company at Toledo, having his office on North High street, and he is credited with building up a good business for the road from that point. He was then made local agent at Toledo, which position he held until the present.

The Mexican National Railroad has decided to establish an agency in the Kimbill House, in Atlanta, about July 10, and Mr. J. J. Griffin has been selected to have charge of this agency, with the title of general freight and passenger agent. Mr. Griffin is one of the best known and most energetic railroad men of the south. He was for thirteen years connected with the East Tennessee, Virginia & Georgia as its assistant general freight agent, and in the same capacity and as general agent with the Southern Railway since its organization.

It is currently reported that President Nathan Monsarrat of the Columbus, Sandusky & Hocking Railway, is to resign. It is stated that this action comes from the present administration of the company to float the two million prior lien bonds by which the indebtedness of the road was to be cleared up. In connection with this report is another to the effect that a prominent capitalist in New York, who is a special friend of ex-president W. E. Guerin, has agreed to take a million of these bonds and place the other million if he is given control of the road. This is taken to mean that Mr. Guerin will again become the president of the C., S. & H.

Mr. B. E. Taylor has been appointed purchasing agent of the Louisville, New Albany & Chicago vice Mr. Craig resigned, and will also perform such other duties as may be assigned him by the vice president and general manager, thus making him practically assistant general manager. Mr. Taylor began work for the Monon in August, of 1887, as stenographer for the general superintendent and has remained continuously in the service of that company through its three changes in management, until the present time. This is a promotion which Mr. Taylor by his courtesy to all and faithful attendance to the interests of the company has well deserved, and he will no doubt be found the proper man for the place.

RAILWAY NEWS.

Baltimore & Ohio.—On June 27 Judge E. D. J. Cross of Baltimore, attorney for the Baltimore & Ohio R., purchased at public sale the Susquehanna & Tidewater canal and the Columbia dam and appurtenances, paying $80,000 for same. The purchase is said to be in the interest of the Philadelphia & Reading R.

California & Nevada.—The Central Trust Co. of New York has commenced suit in the United States circuit court against the California & Nevada R. Co. for $367.050, alleged to be due for interest on bonds issued by the company in 1884. A new receiver is asked to take the place of Mr. C. B. King, the present receiver, as the court is asked to enjoin him from acting any longer in that capacity. The suit includes foreclosure. The complaint recites that on April 10, 1884, the railroad company resolved to borrow $5,000,000 on the issue of 5,000 bonds at $1,000 each, payable June 1, 1894. Of the lot only 545 bonds were issued. The latter were indorsed by the trust company, and for its services the railroad corporation gave its note for $100,000, payable 30 years after date and bearing interest at 6 per cent. To cover its obligations the California & Nevada Railroad Co. issued a mortgage to the trust company on all property, including a proposed line from Oakland to Bodi. It is said that no interest has been paid on the bonds. The action was precipitated by the suit of Charles H. Smith against the railroad company, which was filed on May 28, and in which the circuit court was asked to declare the bonds held by the Central Trust Co. illegal. The road is a narrow-gage line 23 miles long, running from Oakland to Bryant's, Cal. Its equipment at last reports consisted of two locomotives, four passenger and baggage cars, and eight flat cars. It is leased and operated by the Oakland & San Francisco Terminal Co.

Jacksonville & St. Louis.—The reorganization of the Jacksonville, Louisville & St. Louis R., which was on June 10 sold to the bondholders by decree of court, has been completed, and beginning with July 1 will be operated as the Jacksonville & St. Louis R. Circulars announcing the change have been issued by Samuel P. Wheeler, receiver of the old company, and C. M. Stanton, general manager of the road under the new management. This road extends from Jacksonville to Mount Vernon.

Kansas City, Pittsburg & Gulf.—Officials of this line have announced that the road will be opened as far as Many, La., on August 1. This will give the Kansas City, Pittsburg & Gulf 400 miles from Kansas City. The entire line is under contract to Beaumont, Tex., and grading is being pushed. The distance from Shreveport to Port Arthur is 225 miles, of which only 46 miles are in Texas. Track has been laid for some time from Beaumont south to Port Arthur, 19 miles, and that part of the line is in operation. In Indian Territory over 100 miles of track are down, and grading is in progress between the end of the track and Horatio, Ark., a distance of 95 miles. The proposed branch to Lake Charles, La., will be about 25 miles long. J. H. McCarthy and W. T. Kelley of Little Rock, Ark., have been awarded a grading contract on this section.

Mexican National.—It is said that surveys have been completed for a proposed extension to the Mexican National from Corpus Christi to Aransas Harbor, Tex., a distance of 21 miles The Mexican National Railroad connects, by its main line, the city of Laredo with Mexico, having also a number of side lines or branches. Its total mileage is nearly 2,000 miles, and it furnishes the shortest line to the City of Mexico and other of the principal points in the country by about 265 miles. It has connections at Laredo with the International & Great Northern Railway and the Southern Pacific, as well as other important connections at other points along its line. The president of the road is Mr. W. G. Raoul, who was formerly at the head of the Central of Georgia, and Mr. B. W. Thacher is general freight and passenger agent. The road has also offices in London and Paris.

Minneapolis & St. Louis.—What will be known as the New Ulm branch of the Minneapolis & St. Louis road is now in readiness for operation. The new branch, which is 18 miles long, running between Winthrop on the main line and New Ulm, gives the latter place a new outlet to the Twin cities and also a new route to Duluth. Work was begun on the line last fall, and it is announced that the formal opening will occur on July 4.

Minnesota & Wisconsin.—The foreclosure sale of the Minnesota & Wisconsin road took place at Hudson, Wis., on June 25, and the property was bid in by Maurice Auerbach, representing the St. Paul Trust & Title Insurance Co., as trustee, for $80,000. The line at present extends from Emerald, St. Croix county to Spring Valley, Pierce county, a distance of 22 miles, and it is the purpose of the new company to reorganize and extend the road possibly to Durand and on to Merrillan. On June 23, Receiver Dewey, at Medford, Taylor county, sold to a kindred syndicate all the lands and manufacturing appliances. This embraced 50,000 acres of timber and mineral lands and other property to the amount of $220,000. This plant will be reorganized and operated in as successful a manner as possible. Receiver Dewey still has the Eagle Iron Co. plant at Spring Valley to dispose of.

New Orleans & Southern.—On June 26, Judge Pardee of the United States court foreclosed a mortgage against the New Orleans & Southern amounting to $250,000, and ordered that the property be sold within 10 days. This was done in the interest of the Central Trust Company of New York, which has brought suit.

Norfolk & Western.—On June 26, at Norfolk, Va., Hon. Nathan Goff, judge of the United States circuit court, entered a decree ordering the sale of the Norfolk & Western Railroad, and appointed Geo. E. Bowden and Chas. Sharp, both of Norfolk, as special masters to sell the road on a day or days to be fixed by them. The sale will take place at the depot of the railroad company in Norfolk. The lowest bid must not be less than $3,000,000, and no bid can be received without a deposit in cash or certified check of $100,000, or $300,000 par value of bonds, and the successful bidder must deposit at once $250,000 in cash or check, or $750,000 in bonds. The decree declares the company wholly insolvent, and the foreclosure ordered is caused by the default of payment on what is known as the one hundred year mortgage, which is of the date of October 29, 1889. This mortgage was for the issue of bonds to the amount of $16,190,000, under which the decree states there is a present indebtedness—principal, coupons and interest—aggregating $17,528,728.20. The decree states that the said one hundred year mortgage is a valid and subsisting lien on all the property of the road and its branches, including rolling stock, floating property, shops, stations, lands, piers, warehouses, elevators, etc. The lien of said one hundred year mortgage is subject, however, to certain other mortgages. The style of the suit under which this decree is rendered is the Fidelity Insurance, Trust and Safe Deposit Co., and the Mercantile Co., complainants, vs. the Norfolk & Western Railroad Co., defendant. Ten days are allowed in which to make payment and avoid the sale, which, when made, must be at auction and of the road as an entirety.

St. Louis & San Francisco.—In St. Louis on June 27 at noon, the St. Louis & San Francisco R., was sold under a decree of foreclosure issued by the federal court. There was only one bidder Mr. E. C. Henderson of New York, counsel for the reorganization committee. The purchase price was fixed at $1,250,000, and these were Mr. Henderson's figures. By this auction sale the holders of the third mortgage bonds obtain the Frisco road, wipe out the entire capital stock—$4,500,000 first preferred, $10,000,000 second preferred and $35,500,000 common stock amounting to $50,000,000 and also the third mortgage bonds, aggregating $50,000,000, $23,000,000 of the former and $36,000,000 of the latter being held in the company's treasury. They therefore secure the road, carrying only the first and second mortgage bonds amounting to 31,000,000 which are still a lien on the property. Then followed another auction sale of various property in the hands of the receiver not included in the other order of the court. On Monday a temporary organization of the new company was effected. Mr. D. B. Robinson has been selected for president, and the headquarters will remain in St. Louis.

St. Louis, Avoyelles & Southwestern.—It is hoped that the affairs of the St. Louis, Avoyelles & Southwestern, which are now in the hands of Mr. J. H. Fitch of New York as receiver, will soon be adjusted, and that the new road will be again placed upon its feet. It is understood that the stockholders of the Avoyelles & Southwestern R., who are mostly New York and eastern capitalists, have asked Mr. Fitch to make a thorough canvass of the situation, and it is the intention of the company, or of the stockholders, if his report is favorable, to put up all the money needed and push the road through to its destination and fit it up in first-class shape all around. In the meantime trains are running on the line, but all improvements and the finishing touches to the track have been suspended for the time being.

St. Louis Cape Girardeau & Ft. Smith.—In the United States Circuit Court, the motion of Louis Houck asking that the order of June 5, appointing S. W. Fordyce receiver of the St. Louis, Kennett & Southern Railroad, be vacated, was granted by Judge Adams. Colonel Fordyce stated that the receivership has been tendered to him unsolicited and that he personally did not care one way or the other about the matter; all he had done was as an instrument of the court, to carry out the court's instructions. The litigation on this road began in March, 1893, when E. G. Merriam, who claimed to hold $76,200 of bonds of the St. Louis, Cape Girardeau & Fort Smith Railroad, applied to Judge J. G. Wear of Stoddard County Circuit Court, in vacation, for a receiver, and alleged a default of interest on the bonds and accumulating indebtedness as a reason. An order was made appointing Eli Klotz as receiver, Acting as special judge, George Houck then vacated the order for the receiver and adjourned the Stoddard county court until the regular term, and the next day Judge Wear arrived in Stoddard county and ordered the clerk to wipe out of the record the order made vacating the receivership. The supreme court was appealed to, and finally the case was sent to Judge Green of the Iron county circuit court on a change of venue, where the application was made and finally overruled to set aside the order appointing Klotz as receiver. Pending these proceedings and prior thereto, Merriam had been tendered the interest due on his bonds. Then the Mercantile Trust Co. of New York, a heavy creditor of the company through its trustee, Leo Doyle, began proceedings in the Cape Girardeau county court for the appointment of a receiver, and Louis Houck was named receiver. The St. Louis Republic says: "The St. Louis, Cape Girardeau & Fort Smith R. is about 140 miles long and something less than 80 miles of track is in this state. Judge Louis Houck is a wealthy resident of Cape Girardeau, and it was largely through his instrumentality that the road was built. He has had the real management of the property continuously and never permitted Eli Klotz to exercise any authority. The Houck people fiercely allege that Merriam's effort to have a receiver appointed was in the interest of the Missouri Pacific R. and for the purpose of ousting Judge Houck from control. Whether this is true or not, it is an undisputable fact that the law department of the Missouri Pacific represented Merriam before the supreme court, and General Solicitor Cochran presented the case to the court on one occasion in person. The bonds held by Merriam represent liens on only 26 miles of the road, and were not, it appears, refunded out of the $1,000,000 held by the Mercantile Trust Co. of New York with which to redeem and exchange bonds, and accordingly the court holds there was no occasion to throw the entire road in the hands of a receiver on Merriam's application."

San Francisco & San Joaquin Valley.—Grading is now completed to the San Joaquin river, and the bridge over the latter is expected to be ready for tracks by the end of July. All obstruction to the rapid construction of the road through to Fresno has been removed. The last condemnation suit was disposed of in Madera recently, and grading and track-laying over the recently disputed land will shortly begin. Fresno will probably be reached by the middle of August.

NEW ROADS AND PROJECTS.

Arkansas.—A survey is now being made for the Hoxie, Pocahontas & Northern R. from Pocahontas to Hoxie, where a connection will be made with the St. Louis, Iron Mountain & Southern and Kansas City, Fort Scott & Memphis. It is hoped to have the road ready for operation by October next. Mr. Maxwell Coffin of Little Rock is president. Capital stock, $100,000.

California.—Articles of incorporation of the San Diego & Yuma R. have been filed at San Diego, Cal. It is the intention of the new company to ask the citizens of San Diego to subscribe to a guarantee fund of $480,000 to secure 4 per cent interest on $4,000,000, cost of the road to Yuma. Capital stock, $4,000,000.

Canada.—A new route between Quebec, St. John, N. B., and Halifax, N. S., was opened for passenger service on June 22. This places these three cities in direct and close connection and the line which is composed of the Quebec Central from Quebec to Megantic, Canadian Pacific across the state of Maine and through to St. John, N. B., and thence by the Intercolonial to Halifax, passes through a new and important section of the country.

Florida.—A company has been organized and a charter secured for the St. Johns & Atlantic R. Co. to build a road with main line from Jacksonville to Burnside Beach, with branches to Arlington and Mayport. The new road is a reorganization of the Jacksonville, Mayport & Pablo Co., now in control of receivers. The incorporators are J. N. C. Stockton, J. M. Barrs and W. H. Baker, all of Jacksonville. Capital stock, $100,000.

Idaho.—Grading on the Boise, Nampa & Owyhee, which was projected last year and incorporated in February of this year is completed from Nampa as far south as Snake River—20 miles—and is in progress from that point to Florida Mountain. The crossing of the river will be about half a mile above Walter's Ferry. The work now being done is under contract to the Idaho Construction Co. of which J. J. McDonald of Nampa is manager. The road when completed will be 65 miles in length and will be operated as a branch to the Union Pacific. It will make the business of the great Owyhee mining district tributary to Boise. Headquarters are at Nampa and capital stock is $1,000,000.

Illinois.—The new line which was first surveyed last February between St. Elmo and Shelbyville,—about 25 miles—and which was then named the Chicago & Southern Illinois, is again in hand and it is now said to be the intention of the company to have the road in operation by Jan. 1 1897. Mr. N. R. Olcott, chief engineer of the new line from the south, arrived at Shelbyville two weeks ago with his corps of assistants, and began the final survey locating the line between Shelbyville and Altamont, where it will connect with the Chicago, Paducah & Memphis, which is already in operation from Altamont to Marion, Williamson county. It is alleged the Chicago & Eastern Illinois is interested and that it will expect the right of way through Shelby county under the bond given by Shelbyville at the time that road was extended from Tuscola to Shelbyville.

Minnesota.—Articles of incorporation of the Duluth & Southwestern Railway Co. were this week filed with the secretary of state. The proposed line is to start from a point in the southern boundary of Minnesota, yet to be selected and run northerly to Red Wing. From there the line is to be projected in a generally northerly direction through Minnesota and Wisconsin into the city of Duluth. The incorporators are Messrs. C. H. Graves, George W. Buck, Jas. T. Hale, P. S. Anneke and W. Buchanan of Duluth, and Lucius F. Hubbard of Red Wing. Capital stock $300,000.

New York.—Mr. Warner Miller appeared before the New York State Railroad Commission June 29, in the interest of a new railroad which the Upper Hudson R. Co. proposes to construct from Corinth, on the Adirondack division of the Delaware & Hudson R. Co., to Glens Falls. Ex-

Senator Miller was a witness sworn before the board, to show that the road was a necessity. Much of his pulp and paper mill interest lie in the region traversed. The board granted the application for permission to build.

Ohio.—It is said that the majority of the right of way for the proposed Cleveland & Southwestern R. between Lima & Spencerville, has been secured, and the work of securing right of way west from Spencerville is being pushed with all possible speed. It is hoped by the representatives or the road at Spencerville that all the right of way will be secured before the last of August, at least enough to warrant the commencement of construction.

The Toledo, Bowling Green & Fremont electric line, which was to have been completed by the Fourth, has been delayed on account of the failure of some of the supply companies to deliver material as contracted. All of the grading has been done for some time. The masonry and iron bridge work will be completed this week, and half of the posts are in place. Chief Engineer Riggs says that he expects to begin laying the rails in the near future, and it will take about a week to put down the iron when the work is started.

Texas.—There seems to be a very general desire on the part of the people of the Brazos valley, that the Gulf Brazos Valley & Pacific railroad should be constructed. A charter was granted some years ago by the state of Texas for the construction of this road from Red river on the north to the Gulf of Mexico on the south, by way of Mineral Wells and Brazos valley. This charter still has a legal existence, and is of great value, for the reason that a similar charter, under existing laws, covering a line 400 miles in length, would require that bona fide subscriptions of $1,000 a mile to the stock of the company would have to be obtained, of which amount, 5 per cent, or $20,000, would have to be paid in cash into the company's treasury. Meetings are being held in that section and a fund has been raised to cover the expense of its promotion, including compensation for the secretary of the road, who has had large railroad experience, and is especially fitted to carry the undertaking through to a successful conclusion. The Gulf, Brazos Valley & Pacific Railway Company has a large part of its line surveyed and a portion of it graded, and it is thought it will prove to be one of the best paying trunk lines in the southwest. The great fields of coal and petroleum that exist on the northern portion of the line will become valuable factors in the earning power of the road, and in connection with the rich and diversified products on the entire line, will insure large local as well as through business. This road will traverse the most fertile part of the United States, and it will be the most western, north and south line of railway in Texas, tapping several western lines, which will serve as feeders. Beyond all doubt it will become the great cattle road of the state, and its passenger business will from the start be largely remunerative. In order to place the road in position to secure money required for construction on its bonds, the people of Mineral Wells and Palo Pinto county, Palo Pinto county propose subscribing to the stock of the company, $1000 a mile for the distance that the road runs through Polo Pinto county, in addition to donating in addition to donating right of way and depot grounds, paying into company's treasury 5 per cent for engineering and general expenses. The remaining 95 per cent of subscriptions to be expended for grading in Palo Pinto county. It is now in order for the people of the Brazos Valley to extend similar support to this meritorious enterprise, with the belief that the stock of the road will pay good interest on its par value, and that the benefits to the country through which it will run will amply compensate everyone for all aid extended. It is thought there will be no difficulty in placing bonds covering cost of construction of the road, which at present prices of labor and material can be built for about one-half of the amount the other roads in Texas are bonded for. No issues will be made of either stock or bonds except for full value. There is a large and growing sentiment on the part of the people of Texas in favor of the construction and ownership of a great trunk line railroad from Red river on the north to the Gulf of Mexico on the south, connecting the northern trunk lines with the markets of the world at tide water. It is expected that the road will be met at Henrietta by a line now being built, which will, in conjunction with present connecting roads, give the road the long haul in Texas, over what will be for the greater portion of the state, the shortes line to the great markets of Kansas City, St. Louis and Chicago. It is thought possible to incorporate in the trunk line some existing short lines now in operation, and to commence the work of construction at an early date.

INDUSTRIAL NOTES.

Bridges.

—The Berlin Iron Bridge Co. of East Berlin, Conn., has secured a contract for a steel rolling mill building, 103 ft. wide and 112 ft. long, for the Pennsylvania Bolt & Nut Co. of Lebanon, Pa. The building will have a steel frame and roof and sides will be corrugated iron.

—The temporary bridge recently built to take the place of the one destroyed in a wreck on the Roanoke & Southern division of the Norfolk & Western system, between Roanoke and Winston, N. C., will be replaced by an iron and steel structure.

—General Manager Joselyn of the Blair Line made a proposal to the St. Clair county court to build and maintain a steel wagon and railroad bridge across the Osage river at Osceola, Iowa, provided the county would pay $10,000 towards the cost, in annual payment extending over nine years. The Blair Railroad proposes to spend $50,000 in crossing the river and elevating its tracks above the flood line.

—It is stated that the county commissioners have decided to rebuild the bridge over the river at Biddeford, Me., which was swept away by the March freshet.

—The wooden bridge at Asheville, N. C., is to be replaced by an iron bridge.

—The city authorities of Providence, R. I., have voted to ask the legislature for permission to issue $325,000 in bonds for rebuilding the old Great Bridge in that city, according to reports.

—The Phœnix Bridge Co. is now preparing the drawings of the West Falls bridge, and work on the structural material will soon be begun in the shops. The bridge when finished will be the finest ever erected by the Phœnix Bridge Co. Of the many bridges that span the Schuylkill river, it will be the longest. It will be 90 ft. above the river, 1,192 ft. long and 77 ft. wide. Each of the four arches will have a span of 208 ft. It will be divided into three sections, one for a roadway, one for trolley tracks, and one for a path, 40, 25 and 12 ft. in width, respectively. The approaches will be attractive features of the bridge. They will be truss spans that will cross the drives and the Philadelphia & Reading Railroad tracks in West Park. It will take about 3,000 tons of steel for the structure.

—The Chattanooga Co., Limited, is moving for the construction of a bridge across the Tennessee river at Chattanooga.

—Plans have been completed for the Butler & Pittsburgh Railway bridge over the Allegheny river at Harmarville. The president has signed the bill authorizing the work. The bridge is to be 3,000 ft. long and 130 ft. above low water.

Buildings.

—It is announced that the Grand Trunk is to build a fine new passenger station at Portland. Negotiations are in progress which it is expected will result in the railway company securing possession of the Curtis shipyard at East Deering, which is adjacent to the Grand Trunk tracks. It is the intention of the company to construct a new roundhouse and coal sheds upon the property, which is admirably suited for the purpose.

—The Creston (Iowa) Daily News says the C., B. & Q. R. Co. has decided to locate machine shops and a roundhouse at Knowlton, on the line of its road. A tract of 120 acres of land has been purchased, and the buildings will be commenced soon. Work has been resumed in the Fort Madison Iron Works in Fort Madison.

—It is rumored that the Baltimore & Ohio Railroad has decided to remove its shops from Connellsville to Glenwood (Pittsburgh), and will concentrate all work at this point. Plans for the additional buildings have been prepared.

—It has been stated that owing to increased business of the Boston & Maine Railroad it has been found necessary to have more room for the company's repair shops than is furnished by the plants at Salem and Lawrence, and that the officers have finally selected a tract of land comprising several acres just south of the business section of Concord, N. H. Here will be erected this summer a dozen or more buildings. The architect is reticent, but from the size and nature of the buildings it is judged that this plant will not only be used as a repair shop but also for the construction of cars and locomotives; the latter a line of work which the Boston & Maine has never attempted before. The shops at Salem and Lawrence probably will not be abandoned, as it will still be necessary to have some place of that nature near Boston. But after this year the headquarters will be at Concord, and hundreds of men will be employed there.

—A dispatch from Tampa, Fla., says that it is understood that in the event of fresh water being secured by the boring now in progress at Port Tampa City that the general shops of the Plant system will be removed to that city. It is also said that not only would the rolling stock be repaired at the plant, but that works for manufacturing locomotives and cars be added. No confirmation of these reports has been received.

Iron and Steel.

—Work on the enlargement of No. 1 Blooming mill of the Pennsylvania Steel Co. has again been resumed. Work on the extension of the mill was commenced before the company went into the receivers hands and a large part of the machinery was completed at that time. The old structure will be torn down and the new will be constructed of iron and steel. Four traveling cranes will be erected and 26 pits built. The building will be 82 ft. in width and will be first class in all its appointments.

—The company which will erect the new steel plant at Sharon, Pa., is capitalized at $500,000, and will erect a plant to cost about $350,000. The directors are: John Carley, T. J. Forker, Hon. J. S. Frint, F. H. Buhl, Theodore Buhl. The officers elected are: Frank Buhl, president; Theodore Buhl, vice president; David Adams, treasurer, and J. M. Pressley, secretary.

—The works of the Universal Construction Co., which recently leased the North Mills of the Illinois Steel Co., are now in full operation. The reports regarding a strike at the works were greatly overdrawn. The company offered the same and in some cases higher wages than are paid at Pittsburgh, and the first men to apply for places declined to accept these wages, and tried to prevent others, who were so inclined, from going to work. Those who sought to intimidate were not strikers, inasmuch as they had never been employes of the concern. A full shift of men are now at work and are rolling beams without interruption.

—Twenty-four thousand tons of new steel rails have been ordered for the Baltimore & Ohio R. by General Manager Greene. They will be furnished by the Carnegie Steel Co., the Illinois Steel Co. and the Cambria Iron Co. Delivery has already been begun. The rails will be laid in various places where they are most needed, both west and east of the Ohio river. East of the Ohio river the rails laid will be 85-lb. rails, while west of the Ohio they will be a little lighter. This order is one of the largest ever given in recent years by the Baltimore & Ohio.

Machinery and Tools.

—We are advised that the Big Four Railroad has ordered for its Brightwood, Ind., shops a duplex Ingersoll-Sergeant piston inlet air compressor, steam 10 in.; air 10¼ in.; stroke 12 in.

—The Brown Hoisting and Conveying Machine Company has just sold E. D. Smith & Company, contractors, to be used on the work of extending the wheel pits of the Niagara Falls Power Company to accommodate seven more 5000 horse power turbines, which contract was recently awarded to Smith & Co., two of its standard 10 ton locomotive cranes, fitted with extra large drums to take the great length of rope that will be required in hoisting out of the wheel pits.

—What is said to be the largest boiler in America arrived in New York City on the 20th inst., having been shipped to the New York steam Heating Company by the builders, the Edgar Boiler Company of Warren, Pa. It is about 50 ft. in length and 13 ft. diameter, and costs $12,000 at the works. It was loaded on a flat car specially built for the purpose of conveying it, and it was carried over the Pennsylvania Railroad to Jersey City, N. J., where it was transferred to a railroad float, and conveyed thence to New York City.

—The Davis & Egan Machine Tool Company of Cincinnati, O., has lately received orders from England for the following tools: Seven 22½ in. drills, four 14 in. lathes, two 16 in. lathes, one 20x10 lathe, one 18x8 lathe, one 24x24x6 planer, one No. 00 milling machine, and one No. 3 universal milling machine. Most of these tools are to be used in bicycle factories.

—The Murray Iron Works Company of Burlington, Ia., has bought out the Sioux City corliss engine, including the patterns, good will, and machinery, and this well known engine will hereafter be manufactured solely at Burlington. The Murray Iron Works Company is building a new machine shop and making extensive additions to its foundry, and expects to be in the field with the Iowa corliss engine early next fall.

Miscellaneous.

—The Schultz Bridge & Iron Company of McKees Rocks, Pittsburgh, last week launched a large steel compartment barge, the dimension of which are 40x235 ft. and 6 ft. deep. It is constructed of ¼ in. and ⅝ in. steel plates. The first compartment steel barge was built by this firm about a year ago for a railroad company near St. Louis. It has been in constant use ever since, transporting trains across the river in lieu of a bridge, and is said to have been very successful.

—The car wheel works in Birmingham, Ala., have started up and use about 100 tons of iron per day. They will make trucks as well as wheels.

—The National Switch & Signal Co. has been awarded the contract of putting in the large interlocking plant for the new arrangement of tracks of the Philadelphia & Reading, known as the junction of the Norristown and Germantown lines at Seventeenth street and Indiana avenue, Philadelphia. The same company has also been awarded the contract for interlocking the crossing of the Chicago & West Michigan with the Manistee & Grand Rapids Railroad near Baldwin, Mich.; also the contract for interlocking the crossing of the Wisconsin Central with the Chicago, Milwaukee & St. Paul road at Hilbert Junction. Also a 72-lever machine for the crossing and terminals of the Great Northern and the Northern Pacific at Seattle, Wash.; also a plant in Chicago for the crossing of the Chicago, Milwaukee & St. Paul with the North Chicago Street Railway at Indiana street.

—The expedition organized by the National Association of Manufacturers to visit the southernly portion of South America, particularly the Argentine Republic, will sail from New York on July 1. The arrangement of all the details of this expedition has had the personal supervision of President Theodore Search. The number of representative manufacturers who will constitute this group is not as great as was first expected, the difficulty in giving up so much as three months' time just now being in a very great many instances insurmountable; but Mr. Search assures us that eleven substantial representatives of the leading industries of the country will go with this party. They will be accompanied by Mr. Geo. W. Fishback, secretary of legation at Buenos Ayres, who visited Cincinnati some time since. The treasurer in charge of the party is Mr. Harper, who has represented the Philadelphia museum in all South American countries for some years past, and is thoroughly familiar with the language, customs and commercial conditions. Therefore the surroundings of this party will be of the best. Secretary of Navy Herbert has advised President Search that immediately upon the arrival of the expedition in South American ports a man of war will be placed at their disposal as escort, thus giving the party strong national and official endorsement. Reports from this party will be awaited with anxiety and interest by manufacturers at large, but particularly by members of the National Association of Manufacturers, to whom the benefits of this undertaking will certainly inure.